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SUNSET IN THE GOBI DESERT

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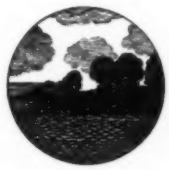
MARCH-APRIL
1929

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

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THE CENTRAL ASIATIC EXPEDITION IN THE SHADOW OF THE GREAT WALL
The expedition's motor cars stop while the members have lunch on the way to the Gobi Desert
See "Further Adventures of the American Men of the Dragon Bones," Page 115.

VOLUME XXIX

NATURAL HISTORY

NUMBER TWO

MARCH-APRIL, 1929

FURTHER ADVENTURES OF THE AMERICAN MEN OF THE DRAGON BONES

An Account of the Activities of the Fourth of the Central Asiatic Expeditions in Their Work of Reconstructing the Pre-history of the Vast and Arid Region Which Includes the Gobi Desert. Further Proof that Central Asia Was One of the Chief Centers from Which the Reptilian and Mammalian Life of Europe, Africa, and America Radiated

By ROY CHAPMAN ANDREWS

Leader of the Central Asiatic Expeditions
and Curator-in-Chief of Asiatic Exploration and Research, American Museum

PANIC among the foreign population of China is rare. In fact I had never seen anything approaching a panic there until I reached Peking in April, 1927. Then I found most of the foreigners thoroughly scared. Even the year before, when the gates of Peking were closed and sand-bagged, and Chang Tso-lin's wild Manchu hordes were looting and burning the country-side, few foreigners in the capital were even nervous. Dinners and dances, polo and tennis went on as gayly as before.

But in the winter of 1926–27 the Hankow and Nanking outrages had been perpetrated. I need not enlarge upon the details. It is a disgraceful page in China's modern history. The result was to inflame the anti-foreign feeling which exists in the hearts of most Chinese. The murder of white residents and mysterious disappearances of others happened frequently. All legations had ordered their nationals to the seacoast. Every ship that left China was packed to the rails with missionaries, merchants, and others who had resided for years in a country which had suddenly gone mad as though smitten with an attack of the rabies.

Such was the situation when I arrived in Peking in early April. It was a pretty hopeless outlook for continuing the work of the Central Asiatic Expedition in Mongolia. Even had we been able to get the expedition away from China, the American Minister would have prohibited our leaving. Common sense dictated that policy. Still, it was rather disheartening

THE EXPEDITION LEAVES FOR THE GOBI

Escorted by a troop of fifty Chinese cavalrymen, the expedition starts across the plain beyond Kalgan to the foot of the pass near Wən Chuan Hsien

THE LEADER OF THE CAMEL TRAIN REPORTS

Doctor Andrews greets the leader of the camel train, which, because camels are slow-moving beasts, has been on the trail for many weeks longer than the automobiles

THE CAMEL TRAIN ARRIVES

Doctor Andrews and Tserin, the leader of the camel caravan, go out to meet the newcomers who are arriving with the all important supplies

TRANSFERRING SUPPLIES

The camel train having arrived with supplies, the goods are checked and repacked for transportation in the cars and for use in camp

A LINK WITH CIVILIZATION
A telegraph operator of Northern China and his family, with their sole means of transport

to face another season of inaction, for heavy fighting about Peking had prevented us from going the previous year.

It looked very much as though everyone would have to leave China, and we proceeded to liquidate certain immovable effects of the expedition, to put others in a place of comparative safety, and to reduce current expenses to the minimum. I decided to hang on during the summer and winter, hoping that one of those sudden changes that so frequently happen in Chinese politics would give some encouragement for an expedition in 1928. The hoped for happened. Chang Tso-lin raided the Soviet Embassy in Peking and disclosed world-wide plots. North China quieted almost in a day. Still it was months before foreigners were allowed to return to the interior. Then they began to trickle into the back country without the official sanction of their legations.

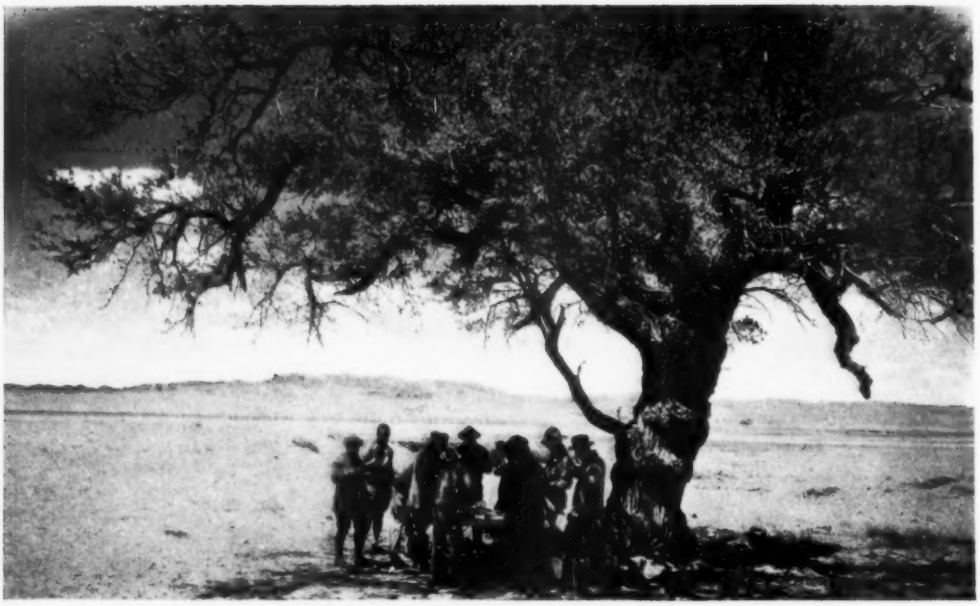
I had promised to cable the Museum by the first of February if the staff were to come out for the spring expedition. At Christmas it looked bad. By mid-January there were slight signs of improvement. It all depended upon whether I had guessed right as to what would happen. Anyway, I decided to gamble and wired for the staff to come.

It would take too long to describe the delicate diplomatic negotiations which had to be carried on to get the expedition away. It is enough to say that they were successful. We slipped out during the month of comparative calm which I had anticipated would precede the usual spring offensive.

For 120 miles north of Kalgan the plateau swarmed with bandits, all soldier deserters. Nothing could pass unmolested without an arrangement with the brigands. We made such an arrangement. The brigand transit tax cost me two dollars and a half each camel. The regular price was five dollars, but we got cut rates because the bandit chief was an

A SHRINE IN THE DESERT
This Mongol shrine is situated in the vast expanse of the Gobi at a spot called Lybaghrin Gol

DESERT ENTERTAINMENT
For the amusement of these native callers, the electric victrola played the latest tunes from America



"THE TREE"
This lone tree was the first seen by the expedition in Mongolia, and advantage was taken of its shade at lunch time

"NAVIGATING" IN THE DESERT
Hill and Granger, with the aid of a Gurley transit, determine the position of the expedition by taking the elevation of the sun. As it is being used here in the desert, the transit takes the place of the sextant, which is used at sea

GATHERING DATA FOR A MAP OF THE DESERT

Throughout most of the country traversed, the expeditions have made maps as they have advanced, thus adding exact typographical knowledge to their great fund of palæontological information

NEW USES FOR AUTOMOBILE TIRES

In the Gobi even the camels sometimes travel "on tires." A cameleer is shown here sewing a section of the tread of a tire over a wound in a camel's foot. It is no more painful to the animal than is the process of shoeing a horse, and the cut is thus protected

THE FURIOUS WINDS OF THE GOBI
No photograph can even vaguely suggest the force of the desert wind. This straining tent, torn by the wind, illustrates an important phase of desert conditions

old friend and he knew that our camels carried nothing that his men could use or dispose of. But we refused to pay the one hundred dollars fee for each of our eight motor cars which the brigands demanded. I felt sure that we could protect ourselves against several hundred robbers. The American Minister, Mr. J. V. A. MacMurray, with his wife and sister, accompanied us to the top of the plateau when we left Kalgan on April 16. His presence was an enormous help to us in our departure. We owe him and all the legation staff our sincerest thanks for the splendid support they have given all our expeditions.

The first day's run through the bandit country was interesting, for we expected to be attacked at every village. But the brigands were afraid to meet us in open fight even though there were some three hundred in the vicinity. They tried to trick us into stopping at a fortified village, but the plan did not work. We knew the habits of the species too well!

Our first working camp was at Shara Murun about three hundred miles northwest of Kalgan. We had discovered the locality the previous year and had done some prospecting there. It was Eocene and very rich. All our plans had been made to explore Inner Mongolia westward to Turkestan. Sven Hedin, the famous Swedish explorer of Tibet, had gone that way, but our work was somewhat different than his and we hoped to find a new route.

While Granger carried on palæontological studies at Shara Murun, I went with some others to hunt a western trail. We found that the one Hedin had followed was the only possible route unless we crossed into Outer Mongolia. That we could not do, as we had no permits. Still it seemed wise to go west and we sent the camels forward.

On May 5, while hunting antelope, I sustained an accidental wound in the left leg from my heavy .38 caliber revolver. The bullet entered in the middle of the thigh, ranged downward, and emerged below the knee. By a miracle it did not

SCANNING THE DESERT FOR SIGNS OF A TRAIL

In the vast expanse of the Gobi there are few trails and the possible routes are difficult. Doctor Andrews is shown here as he attempts to lay out a route for the expedition to follow

THE LEADER OF THE CENTRAL ASIATIC EXPEDITIONS

Roy Chapman Andrews, in camp at Urtyn Obo, takes time to feed two pet eaglets captured in the desert. Appropriately enough, he is using chopsticks with which to feed these Mongolian birds

COOLIES BRINGING IN A FOSSIL

This is the first step, after excavation, that the fossils take on their journey half way around the world to the halls and workshops of the American Museum

THE CAMELS SUPPLY PACKING FOR THE FOSSILS

Fortunately, the camels begin to shed just as the expedition needs material in which to pack the fossil treasures. The great bunches of camel hair, ready to fall off, are consequently carefully garnered in order to protect the fragile fossils

THE DESOLATION OF THE GOBI
This difficult bit of terrain is a portion of the badlands at Urtyn Obo

smash the joint; otherwise I should have had a stiff leg for life. Doctor Perez, our surgeon, did a splendid job in getting me fit again.

The accident delayed us nearly a month, during which the members of the staff were busy whenever the sand storms gave them an opportunity to work. The fossil deposits proved to be moderately good and the archæological stations interesting. Therefore no time was lost except through the weather. For six weeks we had just one terrific sand storm after another. Never have I seen such continuous bad weather. Many days it was impossible to work at all, and the nerves of all the men became strained to the breaking point. We were glad enough to leave as soon as I was able to travel.

The western trip proved to be bitterly disappointing. Not only did we find no fossil deposits but the country was so blanketed with loose sand that motor travel was impossible. It is really an extension of the northern edge of the Ordos and Alashan deserts and is quite unlike the Gobi that we knew in Outer Mongolia. There the terrain is largely gravel, and motors can go almost anywhere. But toward Turkestan great areas of shifting sand and huge dunes make the country a desolate yellow waste, impassable for anything but camels. The archæologist, geologist, and topographer did find some things to interest them but it was a land of utter desolation. Thus the first two months of the expedition were a dismal failure.

The only thing to do was to turn back. It is hard for any explorer to do that. Still the pill was not so bitter, because there was a great area in Eastern Mongolia still unexplored. In fact it was less known than the country which we were in. We had intended to explore it next season. We would do it now, instead, and leave the west to Sven Hedin.

It proved to be a wise decision. Backtracking by forced marches to the Shara Murun, we stopped near Hospital Camp while five of us went off to make a reconnaissance of the eastern country. After

EXCAVATING A TITANOTHERE SKULL
This find was made in the lower white beds of the formation at Urtyn Obo

we had gone, Granger and Thomson made a great discovery of one of the richest fossil deposits in all Mongolia. Pond also found an enormous residence site of the Mesolithic and Neolithic Dune Dwellers, a culture discovered by Mr. N. C. Nelson, our chief archæologist in 1923. On our part, we learned that the east was well worth an extended exploration. New geological horizons were discovered containing a new fossil fauna.

Before we started eastward, the expedition remained for two weeks at Urtyn Obo, Granger's locality. It yielded a series of amazing mammals. Most spectacular of all is a giant beast allied to the *Baluchitherium*. It is certainly a new genus and is probably larger than the *Baluchitherium grangeri*, a skull of which we discovered in 1923. We obtained many parts of the skeleton, from several individuals. Also Shackelford discovered a skeleton which we judge to be more or less complete. It is in such difficult matrix that much time and special preparation will be required for its removal. We therefore had to leave it for next year.

An extraordinary titanothere, unlike any other known form, rhinoceroses of new types, carnivores, and parts of the giant piglike animal *Entelodon* came out of the red and white badlands at Urtyn Obo. The deposit was merely scratched during our two weeks' stay, but we hope to prospect it thoroughly next season. Last summer the expedition's staff was organized for reconnaissance and we could not settle down to intensive palæontological work without keeping many men idle.

The eastern exploration proved to be well worth while. A vast area of Pliocene deposits was discovered. Strata of this age is almost non-existent in the region of our previous explorations. In fossils, it yielded an extraordinary mastodon with

A RHINOCEROS OF THE GOBI
This photograph is of a prehistoric skeleton found at Gur Lung Khara

A FOSSIL FIND
Alonzo W. Pond, of the Central Asiatic Expeditions, is shown in this photograph at work excavating the skeleton of a primitive man in the Sha Kang Usu country

a shovel-like jaw which is one of the most amazing adaptations in the animal kingdom; also many other less spectacular but hardly less important specimens. Our topographer mapped thousands of square miles of uncharted country; the archæologist discovered more than a hundred stations of the Dune Dweller culture, giving a very clear idea of the life story of these primitive people. To me an interesting fact is that without doubt Mongolia 20,000 years ago was much more densely populated than it is today.

The summer of 1928 proved to be the hottest that any of us have ever known in Mongolia. For two weeks the temperature stood at 110° F in the tents and 140° F in the sun. At night the thermometer dropped to 70° F. This extraordinary change of 70° between night and day temperature worked havoc with our gasoline. Although we had devoted more care and thought to the packing of our gas than during any previous year, the loss was enormous. Out of 4000 gallons we lost nearly 1000 gallons. This was due to the great expansion and contraction of the tins in the sun-heat and cool nights.

As a result our expedition ended two weeks earlier than we had intended. Nevertheless, we accomplished most of what there was to be done in the way of new exploration. When we were forced to return to Kalgan, we looked back over the results of the expedition with great satisfaction. There were 87 cases of fossils, containing some of the most extraordinary and important specimens that we have ever found in Mongolia; there were 15,000 artifacts in the archæologist's collections, giving the story of the Dune Dwellers in most of its phases. The topographer had mapped 3000 miles of virtually unknown country; the photographer had a superb collection of photographs and motion-picture film; the geologist had filled in many gaps in the geological column of Mongolia and elucidated the continental structure of thousands of miles. It was a good season's work, taken all in all, and we were well pleased.

DIFFICULTIES OF DESERT AUTOMOBILING
This car of the Central Asiatic Expedition has bogged down unexpectedly in a wet spot while on a scouting expedition to the west of the expedition's camp

Incubating king penguins of South Georgia, with Lucas Glacier in the background. Detail of the American Museum's now dismantled group

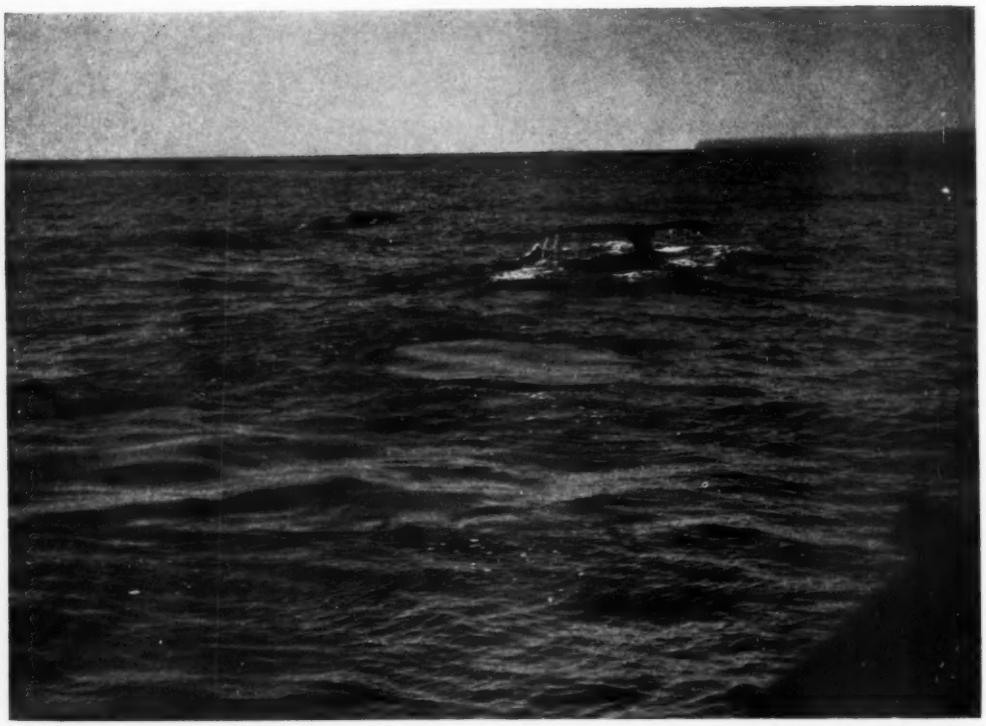
AT THE EDGE OF THE ANTARCTIC ICE

The Animals and Birds that Live Along the Perpetually Frozen Shores of the Antarctic Continent,—Whales and Seals, Sea Leopards, Penguins, and Others

By JOHN T. NICHOLS
Curator of Recent Fishes, American Museum

TO dwellers in north temperate latitudes, the Arctic is comparatively close at hand and holds little in the way of wild life that is outlandish, new, or strange. Periodically blizzards come whistling down out of the northwest and bury us in snow. Shore birds that nest on the far northern tundras pass regularly north and south along our beaches and marshes in the spring and autumn. The cool touch of the Labrador Current permits the same kind of white whale that Amundsen and Ellsworth saw from the dirigible "Norge," when the creature showed itself in an open lead near the North Pole, to disport for the edification of summer tourists in the Gulf of St. Lawrence; and along the Atlantic steamship lanes in winter the identical dovekies, or little auks, whose arrival will mark the return of spring for the Eskimos, are sometimes to be seen, flying about in the air, or swimming under the water (with their wings as their chief means of locomotion).

But the Antarctic is different. That June is midwinter there is not its only contrast with the north. Instead of being an intangible point on a living, drifting ice pack which covers a wide, deep sea, the South Pole is situated on and surrounded by a high, more or less mountainous land mass. This Antarctic Continent has been buried under ice and snow for so many ages that such life as it may have had at some time in the distant past has ceased to exist. It is essentially dead year in and year out. No polar bear, no musk ox, no fox, or wolf, or hare, leaves its tracks across the frigid deserts of never melting snow and ice. No redpolls or snow buntings come flitting back with the low sun during that travesty of spring that comes in September and October to the far



Photograph by R. C. Andrews

FLUKES OF A HUMPBACK WHALE

This photograph of a diving whale was taken in the North Pacific, but the same kind of whale is also to be found along the edges of the Antarctic Continent

southern continent. No shore birds or wild fowl nest on the frigid slopes, which never, even for the shortest of seasons, thaw out. There is nothing in all Antarctica to compare with these creatures of the north.

On the other hand, this barren continent of snow and ice is surrounded by a comparatively ice-free Southern Ocean fairly teeming with life, which, for the most part—as regards the higher animals—is quite unlike that of the cold northern seas.

It is interesting to note that the area of the Antarctic Continent is almost the same as the area of the Arctic Ocean. Where, in the north, explorers make their bases on the edge of the land masses that extend toward the south, and turn northward to cross the floating ice pack, explorers in the south do the reverse. Their bases must be at the shore line of the southern sea, from which they turn away in order to penetrate an ice-covered continent that extends to and around the pole.

Any Antarctic expedition, then, must have its base at or near the southern shore of the Southern Ocean, the northern boundary of which is climatological rather than physiographical, and may be said to lie along the northern edge of the Westerly Winds—that is to say, somewhat south of the thirtieth parallel of south latitude. The southern shores of Australia, of South America south of Valparaiso on the west and of Buenos Aires on the east, and the Cape region of Africa, all border on this ocean. It is the characteristic life of this Southern Ocean that Antarctic explorers encounter, and of which they tell us.

To begin with fishes, several kinds of sculpins are plentiful in the far northern

Drawing by Lynn Bogue Hunt

A SCHOOL OF KILLER WHALES

These ferocious mammals, which reach a length of about thirty feet, are common in Antarctic waters. They congregate in small schools and often attack whales much larger than themselves, tearing and devouring pieces from these great mammals

Photograph by R. C. Murphy

A SEA LEOPARD OF SOUTH GEORGIA

Napping contentedly on ice floes at the foot of Grace Glacier. His mouth is wide open in a comfortable yawn, and the flippers are crossed on the breast. This particular animal was shot by Dr. Robert Cushman Murphy. When dissected, it had in its stomach the remains of four king penguins with a total weight of 136 pounds

seas, and not dissimilar appearing species in the south were at one time classed with these. We know now, however, that the resemblances are superficial, and the southern forms belong to the family Nototheniidæ, peculiar to those waters.

Various whales, on the other hand, are like the northern whales, or show only slight differences which may or may not have been described. Photographs of humpback whales taken by Dr. Roy Chapman Andrews on the northwest coast of North America will serve equally well for southern waters.

The killer whale is apt to be very plentiful along the edge of the southern ice. Here also it is peculiarly dangerous, for it has developed the habit of bumping seals and penguins off the ice pans where they have taken refuge from this wolf of the seas. With such a habit well developed, the killer, which, naturally enough, does not differentiate between seals and men, might readily enough bump some careless explorer from an ice pan into the sea, there to serve as the *pièce de resistance* for this fierce and always hungry diner. The killer seems to be the only whale that has the habit of deliberately raising its head out of the water and looking around —a highly disconcerting and apparently un-whale-like maneuver.

These killer whales, or orcas, remain throughout the year as far south as open water can be found. They are prone to keep together in schools of varying size, and it is said that they often break up heavy sea ice in their search for food.

Sperm whales are rarely to be seen in the cold waters of the far southern sea, although occasionally one is captured by the whaling stations of South Georgia, in the sub-Antarctic. Humpback whales (*Megaptera*) and fin whales of several species (*Balænoptera*) are common, however, even in the very shadow of the great Ice Barrier.

Far southern seals are of species unlike those in the corresponding north. The widely distributed sea leopard is a partic-

Photograph from the Australasian-Antarctic Expedition

AN ICE RAVINE IN ADÉLIE LAND

During the great Ice Age some 50,000 years ago, northern Europe may have presented scenes similar to this

Photograph by J. Innes Wilson

ROARING HIS DEFIANCE

Male sea elephant, surrounded by his wives at Cumberland Bay, South Georgia. These sea elephants are typically sub-Antarctic animals

Photograph by R. C. Murphy

A SEA ELEPHANT "PUP" OF SOUTH GEORGIA

The "pup" is pictured engaged in its principal occupation—sleeping. These animals grow to great size, sometimes weighing as much as two tons

Photograph by R. C. Murphy

SOUTH GEORGIAN TERN SITTING ON ITS SINGLE EGG

The bird permitted itself to be touched while on the nest because a snowstorm was in progress. In fair weather the terns are inclined to be shy

Photograph by R. C. Murphy

A MALE SOOTY ALBATROSS AND ITS OFFSPRING

The perch is a narrow ledge of a cliff at South Georgia. A broken ring of white feathers behind the eye of this finest of flyers gives it a perpetually astonished expression

Photograph from the Australasian- Antarctic Expedition

BELOW ZERO, AND AN EIGHTY-MILE GALE

Life in the Antarctic presents extreme perils and discomforts, as is shown by the above picture of a blizzard in Adélie Land

ularly interesting solitary and predacious species The primary food of this creature is penguins, which, being numerous and unable to fly, fall readily enough before the attack of the active, spotted seal.

The great sea elephant, too, is a southern form. It has a cousin that is found north of the equator, but that branch of the family is presumably of southern origin. This ungainly beast does not live on the Antarctic Continent itself, but is common on certain of the sub-Antarctic islands that lie outside the zone of the ice packs.

The Southern Ocean is alive with birds —birds whose life and whose living are at sea. All of these, however, must, at some time during the year, repair to the land to lay their eggs and raise their young.

Perhaps the most dramatic of all these is the majestic wandering albatross—bird of the Ancient Mariner. Its narrow, bladelike wings, which may measure eleven feet or more from tip to tip, are beautifully adapted to its perennial task of riding the prevailing westerly gales. Only occasionally is this master of flight compelled to flap its wings, even for a few strokes, and, helped not hindered by the strength of the wind, it sails serenely on, leaning far to one side or the other as its curving course takes it through the cold air. Sometimes the tip of a wing may cut knifelike through the water, before the bird tilts the other way and sails gracefully and powerfully away on the other tack.

Various smaller albatrosses are also plentiful. Among these, the dark-gray sooty albatross, with its long, pointed tail, is peculiarly graceful in the air.

The heavier-bodied giant fulmar, despite its relatively short wings, soars with equal ease and control in high winds. Spotted Cape pigeons, looking for all the world like real pigeons, except that they have the same sailing flight characteristic of the petrel-like birds of these stormy seas, follow the few ships in flocks in order to pick up scraps from the galley that are tossed overboard by the cook or the observer bent on attracting them. The more windy the weather, it seems, the more certain these birds are to be about

Photograph from the Australasian-Antarctic Expedition

SUB-ANTARCTIC CORMORANTS AT HASSELBOROUGH BAY

The brilliantly white breast and neck of this far southern cormorant distinguish it from the northern cormorants, which are generally dark

Photograph by R. C. Murphy

A GIANT FULMAR GUARDING ITS NESTLING

The cold blue eye and terrible beak of the parent are not its worst threats. It is capable of ejecting the contents of its stomach at an intruder, and its food is mainly carrion

Photograph by R. C. Murphy

A PAIR OF WANDERING ALBATROSSES

The male is tamping down the partly constructed nest with his huge webbed feet, while his mate sits serenely beside him

Photograph by R. C. Murphy

A JOHNNY PENGUIN AND ITS TWO CORPULENT YOUNGSTERS

The Johnny penguins are roly-poly, interested in everything, and quite remind one of small boys. The chicks are anchored to the nest by the weight of their stomachs

Photograph by R. C. Murphy

A DASH INTO THE SEA

These three king penguins are entering the water from the beach of South Georgia. Bands frequently come out of the sea during the warmer part of the day to sun themselves on the beach

ADÉLIE PENGUINS IN THE ANTARCTIC ICE

These birds are quite fearless and courageous, and a human can easily come up close to them, but if they are mistreated, they are likely to become shy and hard to approach

Photograph by R. C. Murphy

A GIANT FULMAR'S NEST IN THE SNOW
Even when such birds are buried by snow, they do not leave the egg

any ship that may be voyaging in those tempestuous waters.

The silver-gray petrel (*Priocella*), Antarctic petrel (*Thalassœca*), and pure white snow petrel (*Pagodroma*) are similar in habits to the Cape pigeon, and the last two are seldom seen even so far north as the latitude of Cape Horn. The little blue-gray whale birds, which skim close to the water in the troughs of the waves, are in some places excessively abundant. Their peculiar color gives them an intangible appearance against the sea background, and was studied for low visibility by United States camouflage experts during the World War. A northerner is apt to think of comorants or shags as being—as a rule—almost as black as crows, but, in the Southern Ocean, species with glistening white lower parts are common.

Penguins are probably the most interesting and peculiar animals of the Southern Ocean. I once heard an intelligent ship's officer, who had long been familiar with them, express surprise and incredulity that they were birds at all. They were not seals, he realized, and they were certainly not fish or porpoises, but why call them birds? However, penguins are true birds, though completely flightless and essentially adapted for a life in the sea comparable with that of seals. Their wings have degenerated into flippers, covered all over with small scalelike feathers and used only for swimming. They travel for considerable distances below the surface with brief periods of emergence for breathing. Some species, when traveling swiftly, leap or "roll" as porpoises do, and in general, when at the surface, they swim and behave much like seals. Most species can leap out of water to a height of three or four feet to land on an ice floe or a rock. They nest on desolate coasts or shore ice, sometimes in large close-ranked colonies. Animals that associate in flocks usually maneuver with a certain coördination and precision, that, in the case of this peculiar and almost wingless fowl, which stands more or less erect on feet placed close under its tail, give the illusion of ranks of trained soldiers.

The emperor penguin, which is quite the largest, stands about four feet high. It "nests," strangely enough, during the long Antarctic night (July to September) on the ice barrier on the coast of Ant-

Photograph from the Australasian-Antarctic Expedition

ON "THE NUGGETS" BEACH, MACQUARIE LAND

From rookeries on the hills, royal penguins come down in long processions each day to fish from the beach

arctica. During the period of incubation, the egg—of which there is but one—is carefully held on the bird's feet where it is covered by a fold of loose skin between the legs. This, on a little thought, will be seen to be an almost essential arrangement, for an egg placed on ice might be expected to go into permanent cold storage. Furthermore, the male and female take turns in thus brooding the egg, for, in the frigid temperatures of the Antarctic winter, even a short period during which the egg remained unprotected, would almost certainly be enough to freeze the contents of the shell.

The second largest, or king penguin, bears a close resemblance to the emperor, but is smaller—about three feet—and is sub-Antarctic in distribution. It has been studied and photographed at South Georgia by Dr. Robert Cushman Murphy, some of whose photographs have been used as illustrations in this article. There are other species of penguins, the smallest of which are about one half the size of the king.

As I have said, the higher forms of life in the far south are, for the most part, peculiar to it. Yet there are certain birds of northern origin to be found there. Furthermore, there are a few that actually migrate from the Arctic to high southern latitudes and return. The Arctic tern, after nesting in the far north, migrates south and crosses the equator. Just how plentiful it is in far southern latitudes it is difficult to say because of the difficulty of differentiating it at sea from similar terns which breed in the south. The Arctic tern, of course, returns to northern regions with the sun to nest in the ensuing year, but perhaps these other terns, which nest on sub-Antarctic islands, are descendants of stragglers from such migrants, that failed to find their way back to their northern homes.

There are other birds to be found in the far south that are, undoubtedly, of northern origin. Among these are several species of the big robber gull, or skua,—birds with great powers of flight. One of these, observed by Sir Douglas Mawson on the Antarctic Continent 125 miles from the coast, may lay claim to being the most southerly of all birds. It is even conceivable that such a skua might cross the South Pole itself, flying from sea to sea, and who shall say that this has not been done—that birds, the most remarkable of migrants—are entirely without the true explorer's instinct?

Photograph by R. C. Murphy

King penguin of South Georgia tucking the egg into warm storage between its thighs after receiving it from its mate

Desolate and devoid of life the Antarctic Continent certainly is. But on its ice-encrusted shores and in the seas that break ceaselessly upon its titanic fringe of ice, Nature has made possible a wide range of unique and fascinating creatures, with which, as further exploration of the Antarctic is carried out, we shall become increasingly familiar.

A LANE
NEAR MARAGHA

FOSSIL BONES IN A PERSIAN GARDEN

Remains of Animals Caught by Streams and Buried in Their Deposits Fifteen Million Years Ago Come to Light Amid the Fruits and Flowers of Persia

By OTIS BARTON

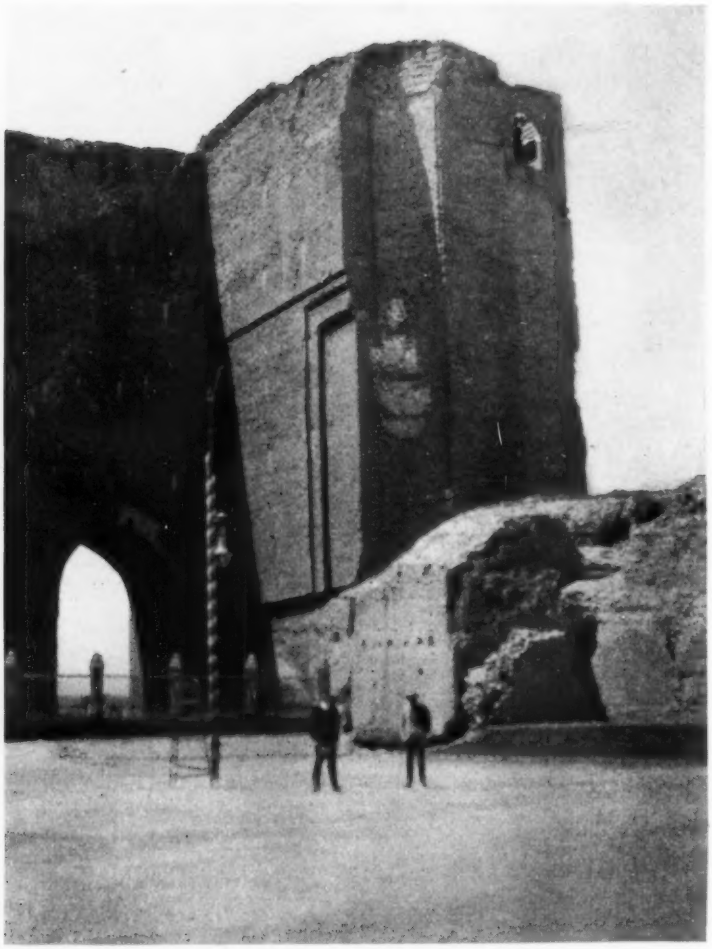
This expedition was organized in the summer of 1928 by Messrs. Otis Barton and Eugene Callaghan, in connection with their studies in geology at Columbia University. The fossil remains of Pliocene mammals collected by the expedition were presented to the American Museum.—THE EDITORS.

LANDING at Batum last summer, we found the Soviet officials courteous and eager to help an enterprise on behalf of the American Museum. The officers of the Near East Relief helped us with our baggage. But soon we were in trouble. I had forgotten to declare a Colt revolver, a very serious offense, for firearms may not enter Soviet territory, even in bond. Accordingly our boxes were ransacked, and we had to send our entire armament back to New York. Neither were cameras allowed, but ours were taken by the railroad in bond.

English-speaking guides not only helped us at the station, but they always refused to accept any tip, saying that their government did not allow it.

Our hopes of going to Western Turkestan to look for fossils were dashed on finding that no automobiles could be obtained in that region, nor would we be allowed to import one, for in Russia automobiles are still an infant industry. At present the cost of construction is higher than in America.

We heard that there were rich fossil beds in Northern Persia, so we finally decided to turn our steps in that direction. Nor was the Persian border difficult to reach on the excellent state railroad. Leaving the squalid Asiatic town of Tiflis in the evening, we awoke next morning to find the train rolling over fertile green plains, with snow-capped Ararat ruling the western horizon. At the border the regulations of the U.S.S.R. again proved troublesome. Paper money may not be taken from Russia, and since no bureau of change was open, we were obliged to take a receipt for 80 rubles. This could only be cashed by returning



THE "ARC" IN TABRIZ

The origin of this ruin is unkown, but it was the only thing left standing after the great earthquake that completely destroyed Tabriz. In the old days, it is said, women who were found to be unfaithful to their husbands were hurled from the top of the tower

over the same route. Our baggage was again searched at length, so that it was with no small feeling of relief that we carried our iron boxes over the bridge into Persian Joulfa. Here automobiles were obtained, and under a full moon we swept southward through the Persian night.

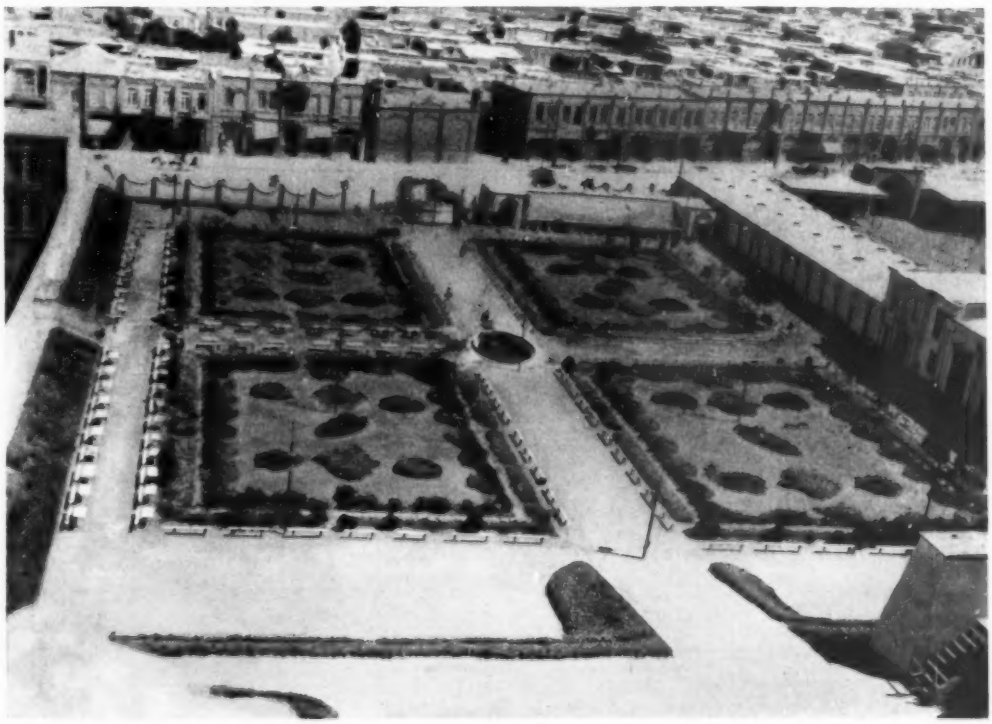
Northern Persia is the greatest carpet market of the world. Even stables and garages have carpets on their floors, that elsewhere would grace a palace. The streets of the great bazaar at Tabriz are covered with carpets. Here we found our way about with great difficulty, for the mud walls around the houses and gardens made the crooked streets look so much alike that we had difficulty in identifying them.

Our consul, Mr. A. W. Ferrin, took us to call on the governor. The day of our visit happened to be a sacred one. Passing through the bazaar, we saw throngs of young Moslems beating themselves on their bare backs with chains. The blows resounded in time to a dismal dirge, and each blow left a bloody streak. This ceremony is a chastisement for the murder of Husein some twelve hundred years ago.

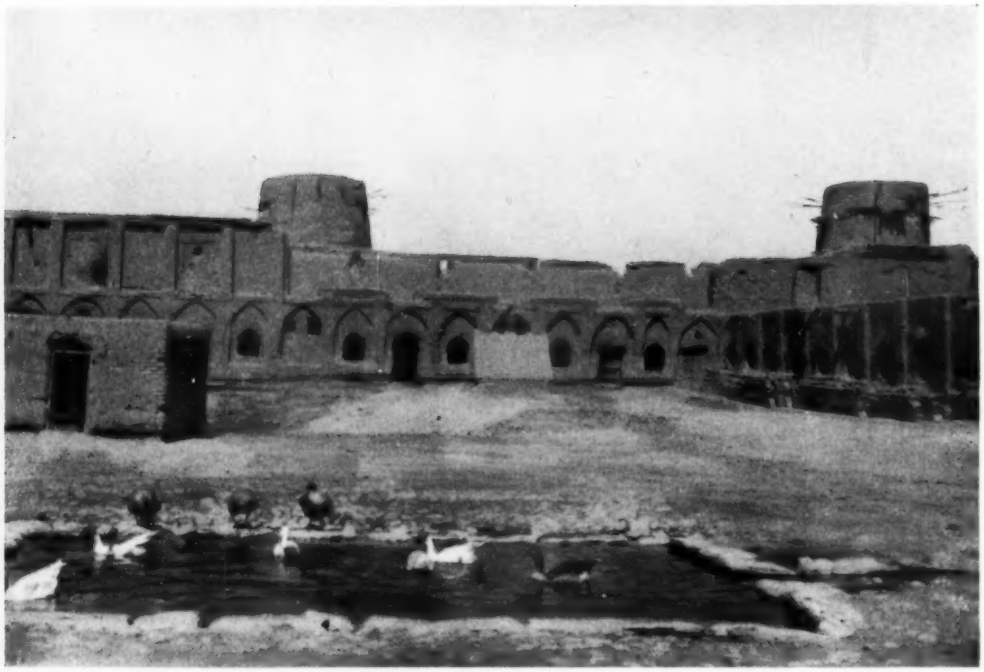
His Excellency was exceedingly gracious. He gave us a letter to the police in Maragha, where we wished to search for fossil bones, and offered every possible assistance.

Not often does the palæontologist fare as well as we did after reaching Maragha. It is set in the midst of gardens and orchards and is the fruit center of Persia. We were able to obtain five different kinds of grapes, watermelons at two for five cents, and walnuts at about a cent a pound. Chickens cost five cents each, and the bread came in great flat sheets from the mud ovens. It was the kind used

A BIRD'S-EYE VIEW OF TABRIZ
Looking west across the Armenian section toward the plains of Urmia



A VIEW FROM THE TOP OF THE "ARC"
This garden, which has long been a prominent landmark in Tabriz, is now turned into an open-air restaurant every evening in summer. Beneath it is an elaborate system from which water is dipped to irrigate the flowers and bushes



THE INTERIOR OF A LARGE CARAVANSERAI
Built originally to accommodate camel caravans, it now caters to modern automobile traffic

by the Romans and helped very much to piece out our supply of canned goods.

We pitched our tent in a shady stream bed, a day's pack ride with donkeys east of Maragha. Our equipment was carried in four iron cases. These rode well on mud guard, donkey, or camel, and in camp their handles could be padlocked together, thus making it impossible for a thief to make away with the whole chain of heavy cases. For rent we promised our army filter pump.

Fifteen miles to the north, Mount Sehend loomed serene and hazy, quite otherwise than in the early Pliocene when this range blazed in a line of volcanoes. At that time several rivers flowed down past the present site of our camp into a sea to the south. Of this sea Lake Urumiah is a remnant.

The surrounding country is today a rolling desert. The hills are of yellow marls and conglomerates deposited in the Pliocene by the rivers from the north. But now the small streams are used by the poor folk of the mud villages to irrigate their fruit trees. These people are peaceable and docile, if one leaves their mosques and their women alone. We employed an old man, formerly with a German expedition, three workmen, a water boy, and a donkey, for less than three dollars a day. For this they arrived at our tent at dawn and worked till dark.

At first we searched the various dry stream beds and draws. Here and there weathered bones were noticed in the dry bare banks. We marked the best places for preliminary surveys. One of the hardest tasks, especially when time is limited, is to determine at exactly what spot to expend the effort of digging. After a few days of exploring, however, we chopped down the bank in two or three places. Our steel pick cut the soft sediment and laid bare the hard white bones. We

usually hacked away at random until a jaw or tooth was exposed by which we could identify the animal. A large block was then cut out and carefully trimmed down. The crumbling bones were covered with shellac, and finally strips of burlap, soaked in flour paste, were wrapped about the block. By the next day the whole would be a compact mass, ready to ship. Rhinos, giraffes, horses, pigs, antelopes, and deer of fifteen million years ago had been caught by the streams and buried in their deposits. Most of these animals differed but little from their living relatives. One tooth puzzled us. It has since turned out to be *Sivatherium*, a gigantic animal looking like a bull moose, but related by its teeth to the giraffe. Not once did we find a skeleton completely intact. But in less than three weeks we had all the skulls and jaws that a Chevrolet truck could carry.

Our second search for bones proved less successful, however. South of Maragha is a large cave in a cliff of Cretaceous limestone. In this, it was said, were many pitfalls, which we hoped might have caught some of the animals or even dawnmen of late Tertiary time. We investigated with ropes and lanterns. The first chamber was a veritable blue grotto. Here many pigeons made their nests. From it we passed into a smaller and darker cave, where bats swooped above us, and then down a slanting passage. Soon the first pitfall gaped before us. It extended nearly across the entire passage. Only along the left wall was it possible to pass on deeper into the mountain. Its edges sloped off gradually at first and were

THE EAST GATE OF MARAGHA
Several native members of the expedition are about to pass through the wall, which is built of sun-baked brick

A COUNTRY ESTATE NEAR MARAGHA

This estate belonged to four wealthy Persian brothers. Beautiful pools are common in Persian gardens, and are usually connected with the irrigation system

THRESHING GRAIN

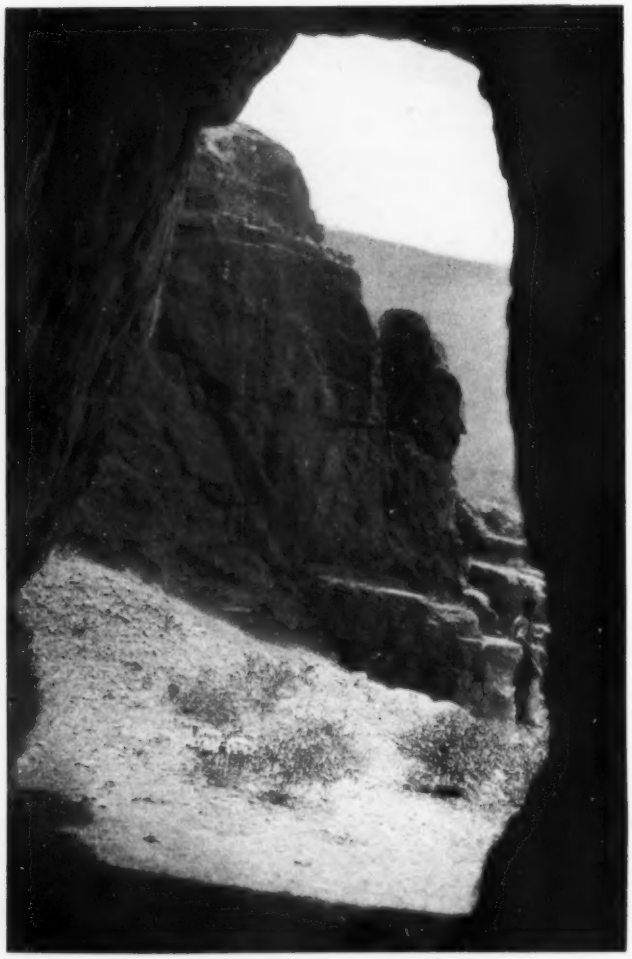
This method of threshing has been in use since ancient times. The runners of the apparatus drawn by the oxen, and the trampling beasts, break the grain from the husks

NATIVE SHOP IN MARAGHA

At the right, dressed in his best to say good-bye to the expedition, is the head man who superintended the search for fossils

IN AN ORCHARD AT MARAGHA

Here fruit is washed and softened in water that has been boiled in buckets over an underground oven. The fruit is then dried and treated for shipment



LOOKING OUT FROM THE BLUE GROTTO
This is the entrance to a series of passages and sink holes which probably extend down to the floor of the cañon

smooth and slippery. This was the place we sought. One rope was tied about my waist. With the other a lantern was lowered into the pit, which proved to be about fifteen meters deep. Both ropes were held fast at the upper end by our Armenian companions. I let myself down hand over hand on the second rope, while the first was kept taut at my waist. Twice I was able to rest on projecting terraces before reaching the bottom. Several of the Armenians followed me down into the pit in the same way. We scratched in the loose débris at the bottom but soon struck hard rock. Farther out we found the hat and staff of a worthy Sunday School teacher, who, four years before, when leading a class of boys through the cave, had ventured too near the treacherous edge and fallen to the first terrace. This discovery nearly caused a panic among the Armenians. Apparently a supernatural return of the deceased seemed to be feared. Further investigation showed that the limestone had been re-cemented, probably in the Pleistocene, so that it was impossible to dig for bones in the hard rock.

Persia, however, presents other difficulties for the fossil hunter. The head of the customs at Tabriz consulted his list of "antiquities," of which no one is allowed to despoil the country. We stood before him, explaining that antiquities were works of man, and that our collection antedated *Homo sapiens*. Alas, "*os mummificé*" was one of the items on his list. So there was nothing for it but to take them over the long road to Teheran, where our minister, Mr. Phillip, could intercede on our behalf.

The first night the boys wished to stop at the bizarre and lurid desert town of Mianne. But we had been warned of an insect of this locality whose bite brings eight months' fever, and we refused to leave the truck. Eventually, we camped farther on by the side of the road—too close, in fact, as I found when awakened by a gigantic and heavily-laden camel

stepping close to my face. Breakfast was taken in a caravanserai. I always hesitated to enter these filthy places, and finally sat down outside.

Near Teheran we were interested to see some Persian women with uncovered faces. It has been the custom for all females of this country to wear a long, black cloak with a hood over the head. To show more than one eye in public was considered a sacrilege, but the new Shah has succeeded in abolishing this time-honored restriction locally.

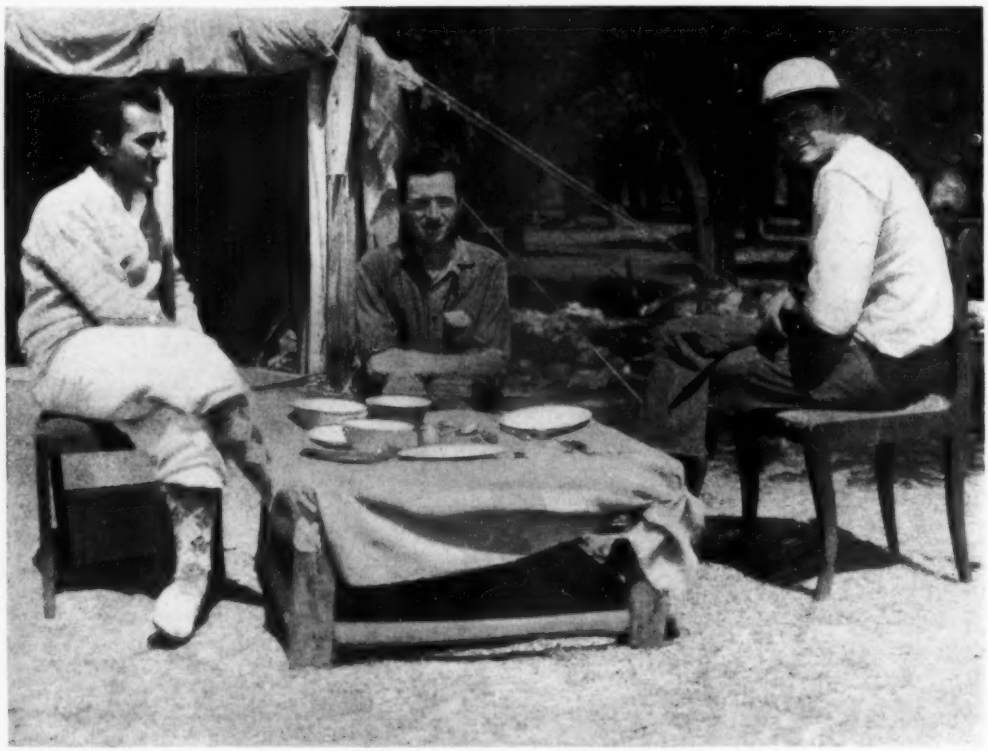
At the capital the fossils were eventually declared by the Persian ministry of education to be antiques, but of no historical value. (I am informed by Doctor Simpson of the American Museum that the converse of this decision is actually the truth.) We were then asked to evaluate our collection in order that the export tax of 3 per cent might be levied. I named the sum of fifty dollars, which seemed to be unsatisfactory to the ministry. A consultation followed, and at last the assistant minister returned and reported the findings of his colleagues. The bones, he was sorry to inform us, were found to be worth one hundred and fifty dollars.

After shipping our cases we were free to take the government airway from Teheran. Flying is at its best in these regions. The desert air is still, and there is no fog. A landing can be made almost anywhere, so that landing fields and hangars are unnecessary. The Junkers plane took off at five in the morning, and soon we were sailing over deserts and ancient cities, and through the gorges of the limestone mountains. This is a vast and miserably poor country, bare of vege-

MR. BARTON WITH A FOSSIL FIND

The skulls of several animals were contained in this block. A wolf skull, apparently complete, together with remains of rhinoceros, deer, and others, was contained in it

ON THE ROAD FROM TABRIZ TO TEHERAN
The car at the right belonged to the expedition. The others are trucks for freight and passengers going to the capital



THE MEMBERS OF THE EXPEDITION IN CAMP
This photograph, taken in camp near Kijave Village, shows, from left to right, Barur Serunian, the interpreter, Eugene Callaghan, and Otis Barton

THE WESTERN GATE TO TEHERAN

The city wall is pierced by many gates, each individual in its decoration and design. Through Kasvin Gate, shown above, passes the road from Tabriz, one of the most traveled roads in Persia

THE BAS-RELIEF AT THE SPRING EAST OF RAY

The carvings originally represented Darius the Great and his court, who evidently visited the spring to "take the cure." About 1500 the warlike Fat Ali Shab carved his own portrait over that of Darius

tation except along the few streams which come down from the ranges.

At Bagdad we changed to the Imperial Airways. This trip was better than that of the famous flying carpet. First, the date palms of the "Garden of Eden" passed beneath us. At its further edge the Euphrates wound like a silver snake. Here was the site of Babylon. Beyond stretched the great Arabian desert. We landed for breakfast at a fort on the "Beau Gest" plan near the oasis called Rutba Wells. In the afternoon we flew over the Jordan and saw Jerusalem in the distance. About six we were over the Suez Canal, when the mechanic sent us back a note: "Passengers for the Rajputana: see your boat in the Canal." Finally, at sunset we came down close to the pyramids.

During these flights we photographed many geological formations from the air with a view to locating by this means, if possible, new fossil beds. Even so erudite a field as vertebrate palæontology may, therefore, be subject to aërial exploitation.

THE JORDAN RIVER AND THE DEAD SEA

The expedition, in flying from Rutba Wells to Gaga, passed this well known Biblical spot. From the air, Jerusalem could be seen in the distance as the plane passed the mouth of the Jordan

THE ANGLER GENERALLY LIES ON THE BOTTOM IN COMPARATIVELY SHALLOW WATER IN WAIT FOR FISHES. IF A DIVING BIRD APPROACHES NEAR ENOUGH, THE SUDDEN OPENING OF THE FISH'S MOUTH WILL CAUSE IT TO BE ENGULFED

WIDE-GAB, THE ANGLER FISH

How the All-mouth (*Lophius piscatorius*) Sometimes Attempts More Than It Can Accomplish. Instances in Which It Has Tried to Swallow Geese and Sea Gulls

By E. W. GUDGER

Bibliographer and Associate in the Department of Fishes, American Museum

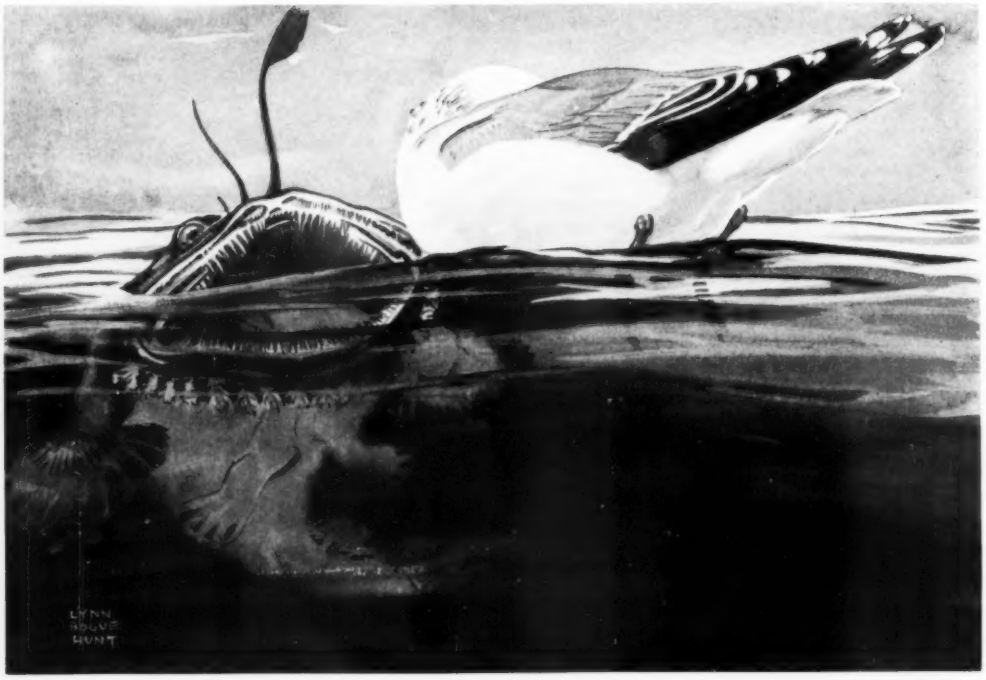
WITH THREE DRAWINGS BY LYNN BOGUE HUNT

THE "angler" is so called because he has on top of the head two or more spinelike tentacles with fleshy lobes or lappets at the ends. Since the days of Aristotle this fish has been credited with dangling the tentacles in front of his mouth to entice fishes to approach, and when close enough, the victims are forthwith engulfed by the rapid opening and closing of the angler's mouth. This alleged habit has recently been established as a fact by a competent observer. As may be seen in the figures, the angler does have a very "open countenance," and on this account two of his characteristic common names are "wide-gab" in Scotland and "all-mouth" in America.

Another common name is "goosefish," given because it is believed that he swallows whole, geese, ducks, and such other aquatic birds as he can lay hold of. Nevertheless, however common and widespread is this belief, the supporting evidence is scanty. Hence I welcome the opportunity to present the following case, for the facts about which I am indebted to Mr. Feodor Deguyieff Polevoy of 100 Ridgewood Place, Staten Island.

On November 19, Mr. Polevoy came to my office carrying a gunny sac having in it a rather large, weighty, and flexible object, which he said was a fish of a kind unknown to him. This sack when emptied gave up a goosefish, which measured 3 feet, 1½ inches long "over all," 15 inches wide over the head, 13½ inches wide just in front of the pectoral fins, and 3¼ inches between the inner edges of the eyes. The huge mouth was 10 inches wide straight across from angle to angle, with a vertical gape of 6 inches.

In both jaws the long, straight, conical teeth are so hinged as to be depressible only in a backward direction. Further, around the entrance to the gullet on the supra- and infra-pharyngeals are patches of backwardly-pointing teeth arranged quadrant-fashion. These are hooked or sickle-shaped and also hinged so as to be depressible backward toward the throat. A pull on any one of both lots of



THE ALL-MOUTH ABOUT TO SWALLOW A SEA GULL
The sleeping gull floating on the surface has its head tucked under its wing, making it easy for the wide-mouthed fish to gulp it in

teeth simply brings it to or (in the case of the pharyngeal teeth) toward the perpendicular. Such teeth readily grasp and hold objects, are easily depressed to permit the inward passage of food, but absolutely prevent any "backing out" on the part of any live object of prey. Furthermore, since the bones and cartilages of both jaws and pharyngeals are freely moveable, it seems that this fish might be able, by working the sets alternately, to "hitch" its prey steadily backward into the gullet.

The fish in question had been caught under the following circumstances. On the morning of November 18, 1928, Mr. Polevoy and some companions had gone out duck-shooting long before day on Raritan Bay, New Jersey, in a rowboat covered with rushes for a blind. In the half light of the early morning (about six o'clock) when some five miles off shore, they saw about one hundred feet away a rather large object threshing around at the surface of the water. In the poor light they were unable to make out what it was. Conjecturing that it might be a shark, a dolphin, or an octopus, they cautiously rowed around it several times, getting always closer. Presently they recognized the object as a large fish with a bunch of feathers protruding from its wide mouth.

The fish threshed about at the surface, seemingly unable to sink. The men then drew the boat alongside, caught the fish with their hands, and hauled it aboard for examination. Whereupon they found that this (to them) unknown fish had a good-sized sea gull so stuck in its throat that it seemed equally powerless to swallow or disgorge it. Just why the fish seemed unable to sink is not clear, but it may be that, in seizing the bird, it had gulped in and passed down into the

stomach, as its relatives the pufferfishes do, a quantity of air sufficient to float it like them at the surface of the water. In this case the bird, caught by the teeth set around the pharynx, could not be expelled, and for some reason could not be swallowed, hence it acted as a plug to retain this air. Once an aquarium pet of mine, a minute pufferfish about the size of a 45-caliber bullet, while distended, got a bit of oyster lodged in its throat, could not descend despite violent efforts, and nearly choked to death.

Such then is the account of the capture of this goosefish. It hardly seems likely that the fish could have caught the bird close inshore and have brought it in its mouth five miles off shore—the sea gull must have been taken while it was floating on the surface of the water, which on this morning was perfectly calm and quiet. This conjecture is supported by the fact that when the bird was carefully extracted from the throat of the fish, its head was found tucked under one wing—*it had been asleep when captured.* Unfortunately the bird itself was not brought in.

Now, lest the reader think this a not unusual case, let us examine the all too scanty literature dealing with the food and feeding habits of the angler. The most extensive investigation ever made on the food of *Lophius* is reported by T. Wemyss Fulton in a paper on "The Distribution, Growth, and Food of the Angler" published in the 21st Annual Report of the Fishery Board for Scotland (Edinburgh, 1903, pages 186–217). In this able article, Fulton records the examination of the stomachs of 541 anglers without finding a single bird in any of them. However, he did find whole fish or fish remains in half of them (269), and concludes that the goosefish is almost

GOOSEFISH AND LOON

Goosefish have often been known to swallow birds of various kinds. The text describes an attempt on the part of an angler fish to swallow a loon, but the powerful bird, though caught, kept the fish at the surface where the struggle was witnessed by a fisherman

wholly a piscivorous beast, as its specific name *piscatorius* implies.

Nevertheless, the goosefish does, at any rate occasionally, eat birds, as our case plainly shows. The few reported instances make a background for Mr. Polevoy's interesting experience. The most definite, and likewise the earliest one known to me, is contained in a short note entitled "Voracity of the Angler (*Lophius piscatorius*)" found in the English journal *The Zoologist* for 1865 (p. 9470). This was written from Dublin, Ireland, under date of December 20, 1864.

The author, Mr. H. Blake-Knox, tells us that there was once brought to him an angler (Irish, *mullagoon*) with a cormorant in its throat. The fish had seized the bird with its portmanteau-like mouth and had swallowed it as far as the shoulders. However, the cormorant was so strong and its feathers were so light, that it had raised both itself and the fish to the surface, where they were caught while struggling—an exact parallel to Mr. Polevoy's case. The bird was rescued from the fish, but was so badly wounded by the fish's long sharp teeth, that it died in a few days.

Mr. Blake-Knox adds that he had personally known of a number of cases where anglers had devoured such diving birds as guillemots and razorbills, and that in one instance he had taken the remains of a great northern diver from the stomach of a *mullagoon*. He had heard of two or three other instances where these birds had been killed by the angler.

Jonathan Couch's *History of the Fishes of the British Islands* (London, 1869) is full of interesting natural history matters. In Volume II, page 209, he describes an incident that almost exactly parallels the two already given. A struggle was once perceived going on at the surface of the water some distance away. As the boat drew near, it was seen that a goosefish was trying to swallow a gull which it evidently had laid hold of while the latter was floating on the surface. The three-foot long fish had gotten the body of the gull (which was 4 feet 6 inches across its spread wings) down into its gullet and stomach, but (here also) the tail, feet, and the hinder ends of the wings projected from the fish's mouth. It could neither swallow the bird further nor let it go, so both became the prize of the boatman and were sent to a local museum. Couch then concludes with another account of an angler that tried to swallow a great northern diver. Their struggles were so great that they also attracted a fisherman who captured them both.

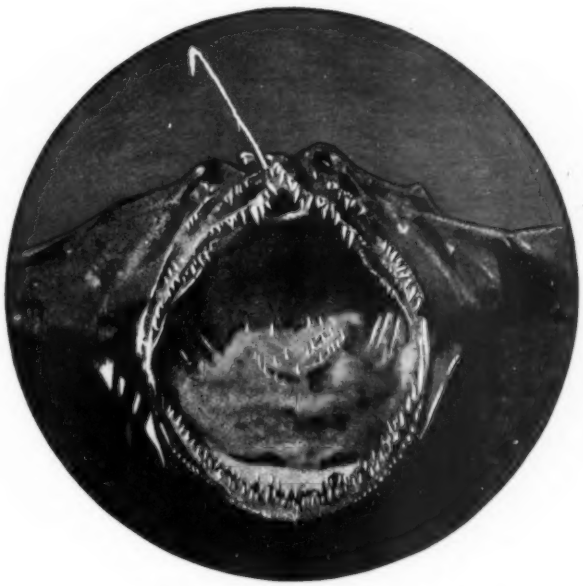
Francis Day, another English ichthyologist, in his *Fishes of Great Britain and Ireland* (London, 1880, Vol. I, p. 75) quotes the account of Couch just given and supplements it as follows. At Belfast (Irish anglers seem especially fond of sea birds) an entire and perfectly fresh widgeon was once extracted from an angler. At Youghal, another, while still alive, was once cut out of a goosefish. Further cases were reported to Day of anglers devouring guillemots and razorbills, and the author expresses the belief that they would probably swallow any bird which they could capture.

Coming now to our own United States, Dr. G. Brown Goode will be quoted from his "Fisheries and Fisheries Industries of the United States, Section I, Text—The Natural History of Useful Aquatic Animals," published at Washington in 1884. On page 169 he accounts for the name "goosefish" because it has been known to take in live geese. A fisherman once reported that, on investigating a struggle going on in the water, he found an angler that had swallowed the head and neck of a good-sized loon. The loon actively resisted any further swallowing and in its efforts to escape kept the fish at the surface. Goode wrote further that he had "an authentic record that seven wild

ducks had been taken from the stomach of one angler"—surely the grandfather of his tribe!

Last of all, Dr. Henry B. Bigelow in the "Fishes of the Gulf of Maine," published by himself and W. W. Welsh in the *Bulletin of the United States Bureau of Fisheries* for 1924 (Washington, 1925, Vol. 40, pp. 526–527), discusses at some length the food of the common angler. He names more than twenty-seven kinds of fishes that have been taken from its stomach, and then goes on to discuss the kinds of birds that have also been found therein. He affirms that, as its name goosefish infers, it feeds on birds, and says that "cormorants, herring gulls, widgeons, scoters, loons, guillemots, and razor-billed auks are all on its recorded dietary." In Pamlico Sound, North Carolina, Doctor Bigelow himself had found grebes and various diving birds, as scaup ducks and mergansers, in goosefish. However, he doubts, and in this he is backed up by the local fishermen there, whether a large goosefish could pull down and swallow a live wild goose, no matter how frequent the opportunity due to the great abundance of wild geese in Pamlico Sound.

Here then is the evidence that *Lophius*, the goosefish, does feed on birds, and an interesting story it makes. And interesting, too, it would be to enumerate the kinds and quantities of fishes (some as long as itself) found in it—together with the story of how one angler tried to swallow another. Then again, there are interesting accounts of how they swallow such inanimate objects as the wooden buoys of lobster pots and sink nets, seine corks, stones used for anchors, and in two cases anchors themselves. But all this, as Mr. Kipling says, is "another story."



THE OPEN COUNTENANCE OF THE ANGLER

Showing the teeth in the jaws and on the floor of the mouth. On the latter, birds are sometimes caught, and are held there to the discomfiture of the fish

EXPERIMENTS WITH "WONDER CREATURES"

Insects Existed Before Man Appeared on Earth, Have Invaded Most of the Livable World, Can Withstand Conditions that Humans Cannot Possibly Survive, and Are Among Our Worst Enemies and Best Friends

By FRANK E. LUTZ
Curator of Insect Life, American Museum

ON inviting questions at the end of his first American lecture on the "Mechanism of the Muscle," A. V. Hill was indignantly asked by an elderly gentleman, of what use were all the investigations which he had been describing. For a moment Doctor Hill tried stumblingly to explain what practical consequences might be expected to follow from a knowledge of how muscles work. Realizing suddenly how thankless a task it was to prove to his indignant questioner that the work he was doing was useful, Doctor Hill turned to him with a smile, and finished,

"To tell you the truth, we don't do it because it is useful, but because it is amusing."

"And if that is not the best reason why a scientist should do his work," says Doctor Hill, "I want to know what is. Would it be any good to ask a mother what practical use her baby is?"

This article is to give you a peep at some of our "babies," glimpses of some of the experiments we have been trying at the American Museum's Station for the Study of Insects in the Harriman State Park and at the private laboratory of Alfred L. Loomis in Tuxedo. They are "babies" in the additional sense that none of them have gone far enough to mature into a definite scientific report.

THE CRICKETS' CHIRPS

MOST of the more than half a million different kinds of insects live their lives without a sound that we can hear. A few, however, such as the crickets, katydids, and their relatives, with an originality that is the more striking as we consider the multitude of conservatives, have developed not only rather complicated sound-producing organs, but also apparently satisfactory ears. As is characteristic of insects, they have gone about certain functions in a way and with structures that seem to us strange. An interesting essay could be written on this latter point, telling about such things as that insects take air directly to the blood instead of the rather clumsy human method of taking the blood to inhaled air; and not the least interesting thing about it is that the insects' way seems to work better than our way. An intimation of their success will be found in the last of the experiments discussed here.

Several years ago, in reviewing work on insect sounds, I confessed considerable skepticism concerning the utility of these sounds to the sound producers; but the chirping of crickets gave me considerable trouble both then and after the paper was published. The chirping is done by rubbing together highly modified structures on the front wings which seem "made for that purpose." Furthermore, crickets have ears on their front legs, and definite ears are unusual among insects. Since only males chirp (although both sexes have ears) the conclusion has been that the chirping is a sex call.

Having somewhat questioned that conclusion, it seemed only fair that I should test the matter; but watching a female cricket to see if she goes to a chirping male is a time-consuming business and, so, it

seemed desirable to invent a machine that would do the job as well or better than we could. Consequently we made an automatic "eavesdropper." It will have to be improved and its first reports are not to be taken too seriously.

AN AUTOMATIC EAVESDROPPER

A BOX, broadly U-shaped in its ground plan, was made to contain the females. There was a window at each end of the U and where the two arms joined was food and shelter. Each window communicated with separate boxes containing males. One window was covered tightly with thin celluloid that let through the chirps but kept back odors. (Remember that insects have a keen sense of smell and many clearly find their mates by this sense.) The other window was covered with wire gauze that let through the odors and would have let through the chirps also if there had been any in the box with which it communicated. But there were no chirps in that box, because a simple surgical operation on the wings of the males there had completely "dechirped" them without hurting them more than a girl is hurt by having her hair bobbed—and the effect was much the same in so far as they were made more like the opposite sex. The females in the central box could wander about and go to either window. Would they go more often to the one where there were male chirps but no odor, or to the one where there presumably was male odor but certainly no chirps? This is where the automatic eavesdropper comes in.

On the floor of the females' box, just below each window, was a very delicate treadle. When a female came to either window, she stepped on the treadle there and, her weight depressing it, closed an electric switch that completed the circuit through an electro-magnet. The magnet drew aside a pen that was otherwise tracing a perfectly straight line on a paper tape moving at a known speed. Each treadle moved its own separate pen. Clearly, all we needed to do was to examine the tape at our leisure and we could tell not only which window was visited but how often the female came, when she came, and how long she stayed.

As I said, the experiment is not finished; many more trials must be made. Also, the apparatus must be improved, because males do not chirp all of the time, and at present our eavesdropper does not tell us whether a male was chirping at the time of a female's visit or whether she merely went there for the sake of some place to go. Undoubtedly we can, but not easily, make the machine record on the same tape the times when males are chirping. In these preliminary experiments we tried to dodge the issue by the rather clumsy device of occasionally offering the females their choice between a blank and something else.

In "chirp but no odor vs. possible odor but no chirp" the females visited the chirp window 290 times and the no-chirp window 307 times. There is practical equality here. When offered a choice between a blank window and one where there were males that could not chirp the score was 170 to 166. Again equality. "Chirp but no odor" won out over "blank" by 63 to 24 but the numbers are rather small and "blank" scored 65 against 48 for a window where there was *both* chirp and possible odor. Males which were offered several of the same choices paid 86 visits to "chirp but no odor" and only 40 to "possible odor but no chirp"; alsc 80 to "possible odor but no chirp" as contrasted with 44 to a blank window. It seems as though males are more consistently interested in both male chirp and odor than are females, the latter wandering about more or less at random; but that may be a too hasty conclusion.

A few experiments were tried with un-

mated females whose presumed ears had been removed by the simple expedient of cutting off their front legs. There were 27 visits by these virgins to a window where there were both male chirps and possible male odor and none to the other window where there were no males. In another short series of trials where possible odor, but no chirps was opposed to chirps but no odor the score was 14 to 11 in favor of odor, but the numbers are too small to be significant. On the other hand, possible odor but no chirps won out over a rival blank window by the rather startling total of 106 to 1.

One of two conclusions is fairly certain: either female crickets do not get wildly excited over the music of possible mates or there is something wrong with the apparatus. Since the machine practically works itself, once it is started, we shall probably set it going when crickets chirp again, especially if we can get a device that will record the chirps.

TEMPERATURE AND WALKING SPEED

THERE is a very different sort of problem which has greatly interested some physiologists and which may strike rather deeply into the mysteries of animal activities, either muscular or nervous, we are not sure which. For example, Harlow Shapley, an astronomer apparently desirous of improving daylight hours when he could not look at stars, watched ants and noted the speed with which they walked along a path at various temperatures. The warmer it was, the faster they went. A curious thing is that the relation between speed (S_1) at a given temperature (T_1) and the speed (S_2) at another temperature (T_2) closely accords with a complicated formula which represents the speeds of certain chemical reactions at various temperatures:

$$S_2 = S_1 e^{A\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}$$

where e is 2.7183, the base of "natural logarithms," temperatures are measured on the "absolute Centigrade" scale ("absolute zero" being about −273° C. or about −459° F.) and A is a constant that is characteristic of the reaction. Some physiologists think that, by a comparison of the "temperature characteristics" of various animal activities (as shown by a curve representing the speeds of these activities at various temperatures) with the "characteristics" of various chemical reactions, we can discover what chemical reactions control these activities. Possibly we can but, at any rate, it is interesting to find out a little more concerning the influence upon insect activities of all the environmental factors, and this seemed to require a new type of apparatus in which the insect could walk straight ahead indefinitely without coming to a wall and in which the environment could be controlled.

AN ENDLESS TRAIL

A DEVICE something like the wheel in an old-fashioned squirrel cage seemed to be what we wanted, but we wished it to be so delicately balanced and so frictionless that even a tiny fruit-fly would easily turn it. However, if we did away entirely, or almost entirely, with friction, the wheel, once it got started, would go on and on even after the insect had stopped walking. Furthermore, while we were at it, we wanted things fixed so that the wheel would automatically record both the speed and the direction of its turning. As I look back, I do not wonder at the kind, solicitous inquiries of friends concerning the "flywheel," and I even forgive the less kind intimations as to "wheels" in my head. The list of failures is a long one, but here is what worked and it is quite simple.

The track where the insect walks is something like an automobile tire with the insect inside of it. It is made of exceedingly thin, transparent celluloid, the "valve" being a tiny, sliding celluloid

door for getting the animal in and out. The spokes of the wheel are fine silk threads; the axle, depending on the size of the wheel, is either a needle or the shaft of an almost obsolete thing, a hat pin. Over each end of the axle is an electromagnet whose strength can be quickly and accurately varied by a rheostat conveniently located in the circuit. Now: An insect is put into the wheel, just enough electricity is sent through the magnets to take practically all the weight off of the bearings (a trick suggested to me by Prof. R. C. Wood), and the insect can go as rapidly as it pleases but, like Alice and the Red Queen, it never gets anywhere. If it decides to stop, we can decrease the strength of the electric current; this lets the weight press on the bearings and friction stops the wheel.

Since an observer is usually on hand when the apparatus is being used, there really was not much point in having it self-recording but, compared with getting the wheel to work, that was easy, and there is some satisfaction in finishing what one starts out to do. Accordingly, a disk of opaque paper was fitted to the wheel and a series of openings was made in the disk. A photo-electric cell was put back of the disk and a beam of light was directed against its front. Every time an opening passed the beam of light, as the wheel turned, an electric impulse went through the photo-electric cell and worked a pen on a recording tape much as did the cricket treadle already described. The openings were so arranged that the turning wheel "telegraphed" a code message that told exactly what it was doing.

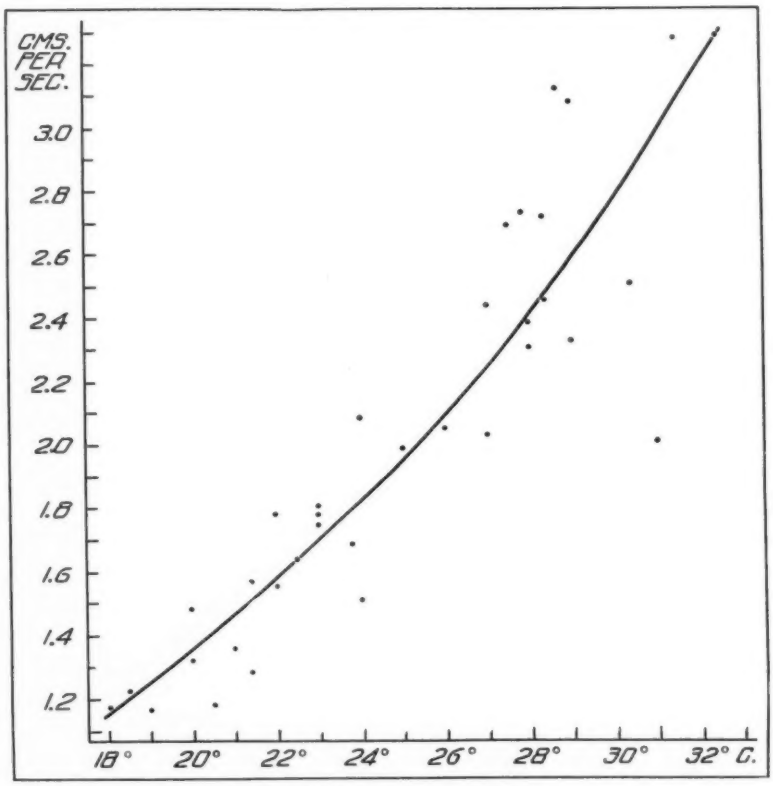
POOR WALKERS AND GOOD

HAVING the apparatus, there was an obligation to use it and, I confess, this was more like work, although interesting. Not every insect is fit to go in such a wheel. Some are what the boys called "Coolidge Bugs," they did not choose to run but sat calmly, as though thinking about something. Others had the will to walk but got tired, for the inside of a freely turning wheel is a trail that has no end. Thus, a yellow-jacket wasp that, in ordinary life, flies much but walks little, started off with an evident intention of getting somewhere in a hurry. For the first twenty minutes it kept steadily going at an average speed of about 9.5 cms. per second. Then, temperature, light, humidity, and barometric pressure remaining the same, it began slowing up, its average speed in successive five-minute intervals being 8.3; 7.7; 7.4; 7.3; and 6.2 cms. per second. At the end of the three hours and a half it was still at it but going only 3.9 cms. per second, having had the longest walk of its life—about two-thirds of a mile.

Ground beetles (Carabidæ) are much more used to walking than are wasps. In fact, they rarely fly. A specimen which Richard Iverson, one of our boys, timed for two hours with the wheel in the open laboratory started off with a speed of 5.3 cms. per second. Its average speeds in nineteen of the twenty five-minute intervals for the last hour of the run were: 5.4; 5.3; 5.1; 4.9; 4.8; 5.9; 6.0; 5.9; (Dick took a five-minute rest); 6.0; 6.2; 5.8; 5.7; 6.2; 6.1; 5.5; 5.6; 6.0; 5.2; and 4.3. Apparently it could keep that up longer than we cared to watch and record. Our automatic disc contraption would have been handy in this case.

The creature that best served our purpose was not, strictly speaking, an insect but *Spirobolus marginatus*, the large brown milliped ("thousand-legger") of the late-summer woods. It is heavy enough to turn the wheel without the help of magnets; it is a consistent walker; and there is an absolute fascination in watching the perfect rhythm of those many legs hour after hour. Let us examine the effect of two environmental factors upon its speed of locomotion.

A *Spirobolus* was started off at a temperature of 32.5° C. (90.5° F.); then the box which contained the wheel was gradually cooled to 18° C. (64.4° F.); and finally warmed again to 30° C. This took about four hours and a half, the creature walking most of the time. Distance traveled, together with elapsed time, was electrically recorded on a rapidly moving tape. If you are used to reading graphs, the accompanying one will clearly tell the story. The dots on the graph indicate the average speed of walking (see left-hand margin) at various temperatures (see bottom margin) and the slightly curved line is that given by the formula noted above when the constants are Speed of Walking (cms. per second) equals



THE WARMER, THE FASTER

Diagram showing the relation between temperature and the speed at which a "thousand-legger" walks. This graph is explained in the adjacent text; each dot represents the average of one part of the whole experiment

$$2.238\, e^{6351\,\frac{(\text{Temp.}-300)}{(300\times\text{Temp.})}}$$

when temperature is given on the "absolute" centigrade scale. It is quite evident that "the warmer, the faster." What it all means is another question.

AIR PRESSURE AND ALTITUDE

RATHER more startling experiments, perhaps largely because they were in an almost unexplored field, were the effect of changed air pressures,[1] and this requires a bit of comment on the side. At sea level the air above us weighs so much that it balances the weight of a column of mercury about 760 mm. high; in other words, the barometric pressure is about 760 mm. at sea level. As we go up in a balloon (mountains are not high enough for present purposes) the pressure decreases, but not in simple proportion to the altitude. The balloon in which Gray died reached an altitude of about eight miles, and "sounding balloons," carrying recording barometers but not a human being, have attained thirteen miles above sea level. But even that is not high enough for our

[1] An even more unusual type of experiment which we started was the effect of short-length radio waves. If short and strong enough, they kill; but less lethal doses seem to act merely like warming up the creature, although the temperature of the air remains the same.

present purposes. Since we do not know what the air pressure is thirty miles above sea level, about the best we can do is to take a very simple formula which seems to be "in the direction of the truth" even though it is known to be inaccurate. It is that altitude in miles about equals

$$10.33 \log_{\cdot 10} \left(\frac{760 \text{ mm.}}{\text{Observed Pressure}}\right)$$

It may be simpler to look at the curve on the following page which gives on the bases of known facts and of this formula altitudes in miles for various barometric pressures.

WALKING IN LOW AIR-PRESSURES

FOR this experiment *Spirobolus* was put in a wheel; the wheel was put in a bell-jar; and air was pumped out of or let into the jar according to whether we wished to decrease or increase the atmospheric pressure. It was absurdly easy to give the creature all of the air-pressure thrills of a super-balloon ride to, say, fifteen miles above sea level (air-pressure of about 27 mm.) and return in less than three minutes. Of course, since it is well to investigate one factor at a time, temperature, light, and humidity were kept as nearly constant as possible, and for that reason we can speak here of only the effects of air pressure and decreased oxygen supply.

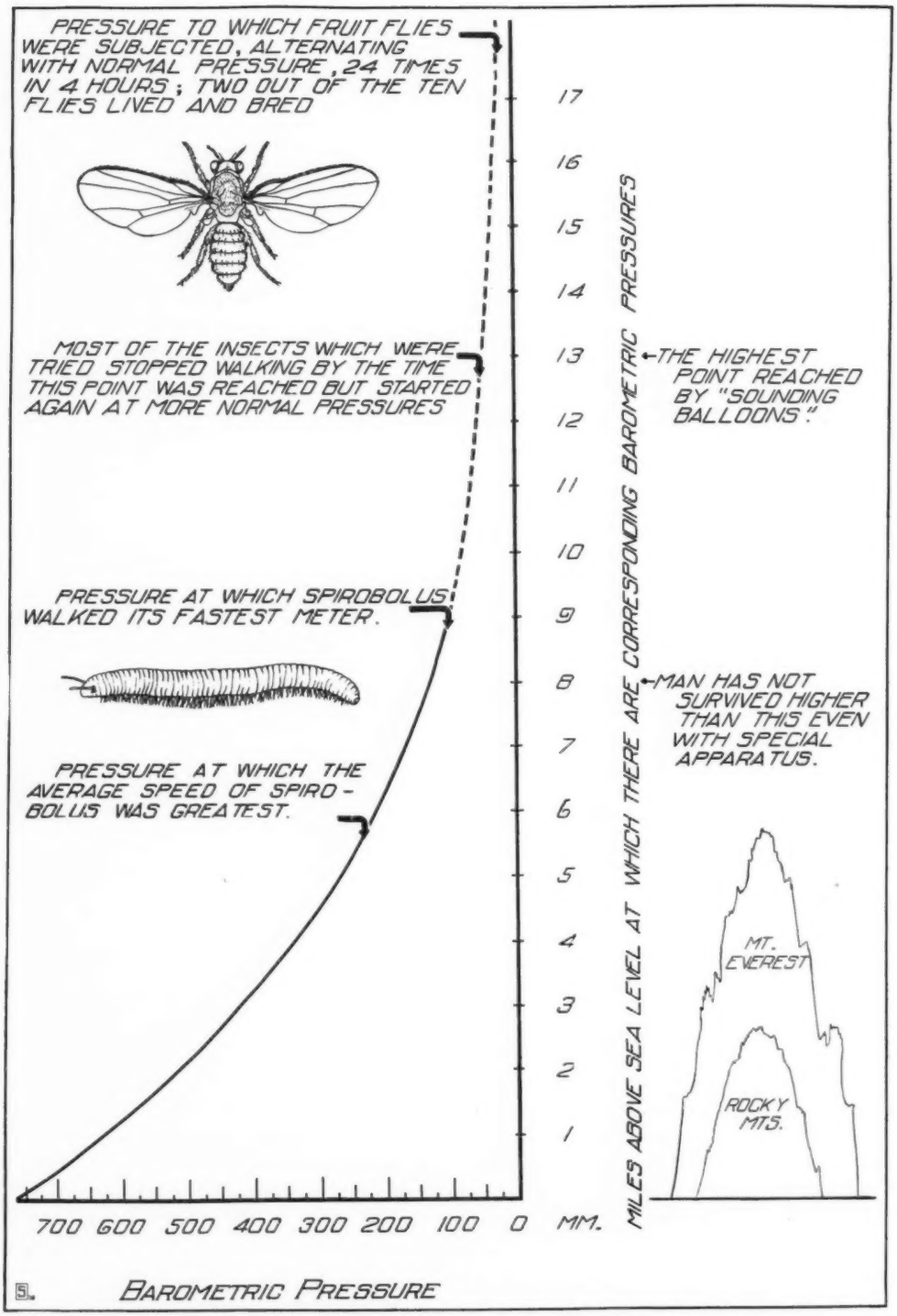
Suppose a man were being treated in this way. Even if the change were made slowly, his gait would be wobbly and his breathing very labored at a pressure of 400 mm. of mercury, and Gray died, whether accidentally or not, when it was about 150 mm.

Since we wished to time the speed of walking at various pressures, *Spirobolus* was subjected to graded series of them. Observations were made during the first hour at 740, 500, 400, 300, 250, 200, 150, 100, 75, 50, 40, 30, and about 22 mm. pressure in succession. In order to have a constant degree of humidity and also to prevent drying of the milliped by excessive evaporation, we had water in the jar and, since the vapor pressure of water at ordinary summer temperature is about 22 mm., that was as far as we went, and it seemed far enough for the present. At that, there was practically no air left in the jar. Then we came by rather short stages back to normal; then went to 100 and back to normal; and repeated this "round trip" three more times—all in two hours and a half.

Instead of walking more slowly as the air became rarer, *Spirobolus* increased its speed, all of its many legs functioning in absolute rhythm. This increase kept up on the average until the air was about two-thirds gone, corresponding to pressures at an altitude of, say, six or seven miles; then it began to slow on the average and stopped (but not for good) when there was practically no pressure left except that of water-vapor. As a matter of fact, however, the fastest one-meter dash that it did was at an air-pressure of only 105 mm. (representing, say, an altitude of about nine miles), making the meter in 59 seconds or a rate of about 1.7 cms. per second. Of what stuff are these creatures made, at any rate?

AN AËRIAL ADVENTURE

WE are all familiar with the tiny, red-eyed fruit-flies that come about over-ripe bananas and the like. Ten of these flies were put in a bell-jar with water and the air exhausted to the vapor-pressure of water in ninety seconds. The flies stopped moving. Valves in the apparatus were then opened wide and the pressure almost instantly returned to normal. Within four minutes all ten were walking about as though nothing had happened. The same procedure was repeated again and again. After the eighth trial one fly did not walk within seven minutes and I did not wait for him but went on with the one- to three-minute



SUMMARIZING CERTAIN EXPERIMENTS WITH REDUCED AIR-PRESSURE

The curved line shows approximately the relation between air-pressure (horizontal scale) and height above sea level (vertical scale) under normal conditions. At the right are human affairs, including diagrammatic representations of the heights of mountains. Entomological facts are given at the left

swings from normal to "none" and back again. After the twentieth trial only six of the ten stalwarts were walking and I took time out for tea. After tea we (the flies and I!) made four more round trips and then only a male and a female of the original ten were still alive. There seemed no point in pushing the experiment to their death and, besides, I wanted to see if they were really as well and hearty as they seemed to be. So, I put them in a cage with a nice ripe banana, where they started breeding the next day. Careful microscopic examination of their children, grandchildren, and great-grandchildren failed to reveal indications that anything unusual in fruit-fly affairs had happened.

Human endurance would fall so far below that of insects in such a test that no comparison can be made. An express elevator in the Woolworth Building or the dropping of a cage in a deep mine are slow coaches going a short block compared to the ride these flies took twenty-four times in four hours, but in what follows we tried to reach the limit of even insect endurance —and failed as far as air-pressure is concerned.

INSECTS AND SUPER-VACUUM

IT is well known that, in order to produce X-rays, the air is almost completely removed from the X-ray tube and then an electric discharge of very high voltage is made to jump the gap between two electrodes in this "vacuum." But the so-called vacuum, while nearly complete, is not entirely so; there are still enough ions left to carry the electricity from one electrode to the other. Furthermore, it is possible, by means of a pump which Mr. Loomis has in his laboratory, to exhaust the tube so completely that the X-ray dies out and even 30,000 volts will not force a discharge across the gap. Instead of an air-pressure of about 760 mm. of mercury, as we have in normal atmosphere at sea level, the pressure now in the tube is of the order of one ten-thousandth of one millimeter. It is probably lower than the vacuum of interstellar space. What would happen to a "frail" butterfly or bee if subjected to such a vacuum and then suddenly brought back to normal pressures?

The answer is complicated by a factor already mentioned, one which we found was more important than sudden and great changes in air pressure. This factor is that the pump which removes the air also removes the moisture; and insects which are kept in a pressure much less than the vapor pressure of water would quickly dry up and die of desiccation. Water cannot be supplied to them in this apparatus, because some of it would evaporate so quickly that what remains would be frozen to solid ice and, in fact, part of the slowing effect of high vacuum on insects may be due to a marked lowering of their temperature caused by evaporation from their bodies. However, let us see what happened.

Three small bees belonging to two genera of the sort that live a solitary life, instead of in colonies, two mound-building ants, a beetle related to fireflies, and an immature grasshopper were put in a tube and the ends of the tube were melted so that it was welded into the apparatus. (Ordinary joints would not hold.) Since moisture would ruin the pump and since moisture was sure to come from the insects, that part of the tube between the insects and the pump was packed in a mixture of solid carbon dioxide and acetone in order to freeze the water out of the air on its way to the pump.

The pump was started and the next three minutes were busy ones. First the vacuum-tube glow appeared, but before the end of the second minute it had died out, showing that a non-conducting vacuum had been reached. This was held for 60 seconds, a rapidly growing pile of

snow in the chilled connection being the moisture sucked out of these "frail" creatures, and then the glass tube was broken at one blow and the insects were returned to normal conditions from their journey into a "complete vacuum." Not one moved then but two hours later all were active and apparently normal. A little later one of the ants showed some signs of trouble but whether it was due to the vacuum, the drying, or to some more natural cause I do not know. The next day that ant was dead but, when released, the other ant and all of its companions each according to its kind flew, hopped, or walked away.

The same experiment was tried with a bumble-bee and two kinds of butterflies, except that the insects were in a vacuum of less than one millimeter pressure for four minutes and the extreme of 1/10,000 mm. was kept up for 90 seconds. In about ten minutes after the tube was broken, instantaneously returning them to normal pressures, the bee and one of the butterflies began to show signs of life. Five minutes later both were walking and the other butterfly was feebly moving its legs and mouth-parts. By the next day the bumble-bee was active as ever but the butterflies had died. Possibly they were unable to withstand the conditions of the experiment, including the excessive drying, and possibly they died from other, more natural causes, but it did not seem necessary to try the experiment again. There was no longer room for doubt that insects and their near relatives are creatures that can not only exercise vigorously at air-pressures which no man nor any of the animals related to him could survive; creatures that can not only completely recover within a few minutes from sudden and rapidly repeated transfers from normal pressures to almost none and back again; but they are creatures that can survive the most complete vacuum that man can produce with exceptionally perfect apparatus. How do they do it; why can they do it?

THE WONDER CREATURES

ALL that we can say is that insects seem to be better made than we are. They have invaded almost every bit of the livable world, including hot springs and the highest mountains, the Arctic and the Tropics, in water and on water, underground and above ground, in plants and animals and on them. Only the ocean is avoided by them. Their structure and mode of living have stood the test of time practically unchanged since the Carboniferous. Possibly Maeterlink was right when he called them "beings so incomparably better armed and endowed than ourselves, concentrations of energy and activity in which we divine our most mysterious foes, the rivals of our last hours and perhaps our successors." On the other hand, as has been pointed out in "The Friendly Insects" (NATURAL HISTORY, Vol. XXVI, p. 147), relatively few kinds of insects seriously injure us and we owe much to many kinds. Possibly, with increased knowledge of insect habits, we may be able to swing the balance still more in our favor.

WHAT good are such experiments as these? Possibly collecting interesting information about the masterpieces of Creation is of no greater value than collecting human masterpieces of art; and possibly writing about Nature is no more useful than writing music; but, until some one is wise enough to be able to predict the worth of any bit of pure (as contrasted with "applied") science, we can at least say that it "amuses" those who do it and interests many who read about it.

ELEVEN WEEKS IN A LION PASTURE

Collecting in Tanganyika for a Superlative Group for the New African Hall That Is to Be Added to the American Museum

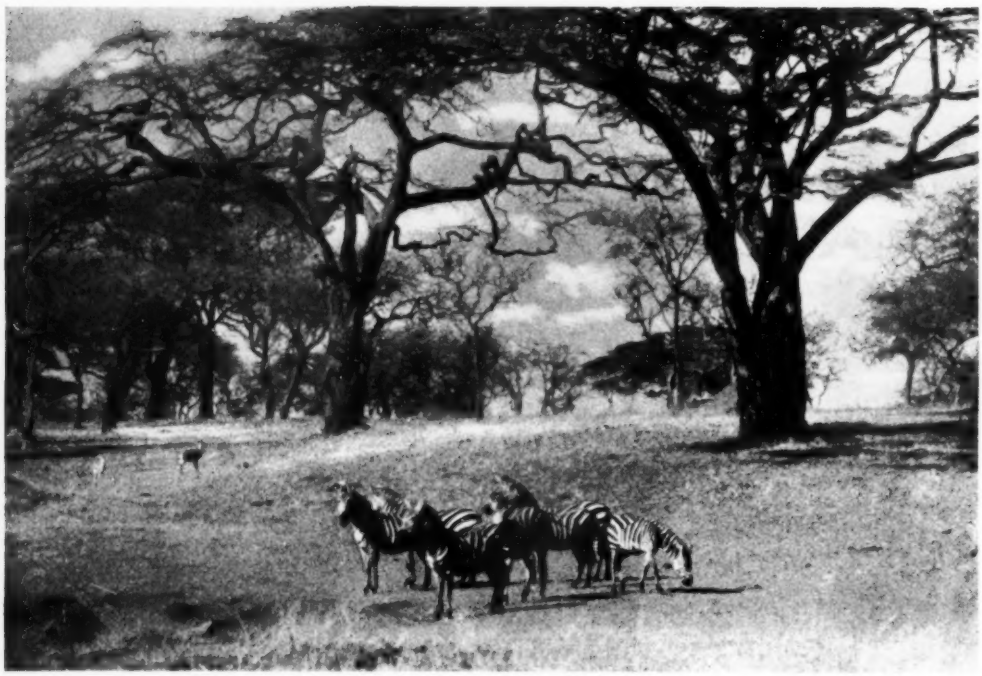
By G. LISTER CARLISLE, Jr.
Leader, Carlisle-Clark African Expedition of the American Museum

The Carlisle-Clark African Expedition of the American Museum was made possible through the generosity of Mr. and Mrs. G. Lister Carlisle, Jr., of Norfolk, Connecticut, and was intended to supply two finished groups for the Museum: a major group of lions and a minor group of suni, the smallest of the world's antelopes. The task of producing a wholly satisfactory lion group requires high talent, and in spite of the press of work, Mr. James L. Clark, Assistant Director, was granted leave of absence to carry out the work. The party consisted of Mr. G. Lister Carlisle, motion-picture photography; Mrs. Carlisle; Mr. Clark, group work; Mr. William R. Leigh, artist; Mr. Richard C. Raddatz, background accessories; and A. L. Klein, "white hunter."

One of the most important objectives of the expedition was to give to the members of the Museum preparatory staff renewed familiarity with the anatomy of African animals and with their habitats, in preparation for the work on the African Hall, and also, in the case of Mr. Clark, the personal knowledge of the White Nile country so necessary for representing that section of Africa. In view of the fact that the expedition was fortunate in having an artist in the party, it was decided to substitute for the small group, paintings for the lesser kudu group, which were needed by the Museum, but were not on the original program. This, however, was in accordance with the plan to render as much general service to the Museum as possible. The party was carefully organized so that complete competency would be available for all of its activities, and the expedition was to be on a non-killing basis, as far as it was humanly possible to achieve this and still succeed in its mission. It was intended to be an idealized museum expedition. The illustrations used in this article are enlargements from motion picture films taken by Mr. Carlisle, and are hardly representative of the best, as it was not desired to cut the film.—The Editors

EACH year we must change our mental picture of Africa and bring it up to date.

Three years ago Mrs. Carlisle and I traveled eleven hundred miles south of Khartoum on the White Nile and found few animals and no tourists. Now regular tourist steamers are run on the route, and animals are scarce indeed. Mr. Clark reports that he did not see a head of game on his way out from Kenya in 1928, and the distance from Nairobi to Khartoum by



ZEBRAS IN TANGANYIKA
A typical scene along one of the water courses

car and boat is about two thousand miles.

And so I found it in South Africa. In traveling by train from Cape Town to Victoria Falls and out on the east coast at Durban, I saw just two hartebeests.

The old buffalo country around the present site of Nairobi is now given over to coffee plantations and charming country homes. The Rift valley, where Theodore Roosevelt found such great game herds, is now uninteresting, almost desert, or cut up into farms; and so it goes over all Africa.

Tanganyika is the least altered area left to us, and shortly we may expect that it also will lose its wild-life interest. At present and for some years to come it will remain the grandest example left to us of the world as man first knew it. Here it was that we hoped, on our 1928 expedition, peacefully to collect our lion group and yet leave the country as unspoiled as we possibly could for the next man and the next generation.

Animal life does not spread itself evenly over a country. Instead, favoring conditions cause local concentrations, with seasonal changes, to be sure, but with the range of movement quite limited and easy to follow. Our objective in Tanganyika was an area such as this, and it may be the last to be found in Africa. This, I well remember, was Carl Akeley's opinion as we discussed the matter before he left on his last African trip.

From one such area of concentration in Tanganyika, more lions, probably, have been taken than from any other area in the modern world, but in spite of the fact that they are holding on, owing to the present abundance of game, they are doomed, as elsewhere, because the lion is a plains animal, lazy and frequently easy to approach. Before the automobile and the modern high-powered rifle he stands no chance at all.

To my surprise I found that most people without actual experience in a lion coun-

try feel that the lion and leopard may properly be shot out of it; and so they may, if the area really is needed for white settlement, but it is a mistake to kill them off from the waste places, as they are the most interesting animals there. One soon tires of looking for expression and individual interest in an antelope, but the lions are different. Their rule over the animals has continued for so long and has been so absolute that it is reflected in their expression, as in their actions, and if you shoot the lions out of a country it becomes "flat" and uninteresting in comparison with its former proud state.

A few years ago a party of hunters from our middle west went after a record on lions in this area and shot between sixty and sixty-five; and then the British changed their laws. They are rather good lion hunters themselves and are particular to inquire how their lions are shot and how many are shot by those privileged to shoot over their preserves.

The game commissioners of Kenya are selected from men of a very high type. At present both the commissioner and the assistant commissioner are ex-army officers of standing in the community and they are making an able and gallant uphill fight to preserve the game against the inroads of all unnecessary killing by settlers and of excessive killing by both sportsmen and some museum expeditions. May they be successful!

The world will be the poorer when the last of the great African game herds has passed into history.

These were the thoughts that were uppermost in our minds as we traveled many weary miles south of Nairobi without seeing more wild life than a small zoo might hold.

But at the end of a week, after two

WAITING NEAR A WATER HOLE

African animals are ever waiting and watching for the sudden attack of lions and leopards. Here a group of zebras and wildebeests are facing in all directions and also watching the animals on the other side of the hole. Sometimes they wait for hours before daring to drink

AN EXHAUSTED WATER HOLE
Four days before this picture was taken a flourishing water hole existed here, but in that time the water supply had been exhausted by the thirsty animals and only mud remained

hundred fifty miles had been covered, we arrived in game country, and what a sight! From then on, for three months, game was always in view. At times we saw very little because the game was "out," as is the local saying, or in other words the migration had passed on from the exhausted water holes of the dried-up plains to the lower reaches of the rivers where they empty into Victoria Nyanza. Later, we followed the game down one of the rivers and there found it in its thousands. The herds were concentrated from a vast area of country and an estimate of their numbers would be misleading and harmful, unless reduced to an acreage basis over their whole range, which is impossible.

The expedition established a base camp three hundred miles south of the railroad, and there our work began. It was serious work that we had undertaken, for this was not a sporting event, nor a trophy hunt, nor an expedition organized for any other purpose than to render service to the Museum, and in so doing to enjoy the picture of unspoiled Africa which lay around us.

The making of a superlative major museum group is an undertaking of size that requires great expertness in execution and hard work, and we at once became the busiest party in Africa, with Mr. Clark directing his departments with energy and ability.

Museum lion groups present a special and difficult problem because of the personality that the lion himself possesses and because of his predominant position among animals. The design and execution of a lion group, therefore, calls for the abilities of an able sculptor, as well as those of an artist and a taxidermist; but all this talent had been provided in our organization and we went prepared for success in our venture.

A present-day expedition to East Africa representing the American Museum of Natural History but follows others which have established a high reputation for the institution among the English residents, and there is a desire on their part to assist in every way possible. My own reaction to this condition was that it was our clear responsibility not to swerve from our intention to kill only the limited number of specimens required for well-defined museum purposes, and just enough of the common varieties of antelope for food. I am glad to report that our expedition lived up to this. Mr. Clark collected for the museum; Mr. Clark and Mr. Klein killed for food; but neither Mrs. Carlisle, Mr. Leigh, Mr. Raddatz, nor I even took out licenses to kill animals. Personally I had a bird license, which I did not need.

The scale model designed by Mr. Clark called for a group of seven lions, headed by a superlative specimen of a dark-maned male, but where to find him became the all-important problem of the expedition. We ranged the country for fifty miles in every direction and inspected, probably, three hundred lions, but the lion of our dreams was found only on the last day of the last extra week given to the hunt!

We are glad to have him!

Every day we saw from two to twenty lions, but they were mostly females or young, and infrequently males with poor manes. The big fellow we needed appeared to have left the country. As the country we were in has not been shot over to any extent and some of it not at all, we knew that lions there die of old age, and that there must be many big males. But these keep by themselves and during the day lie well hidden in the dongas, or stream beds.

MERELY LAZY

In districts where lions are able to find food readily and where they have not learned to fear the attacks of man, they are often easily approached and photographed. Remarkably enough, they seem to have no fear of motor cars

IMPALLA AND THOMSON'S GAZELLES

Tanganyika still supports great heards of antelopes and other animals on which the lions depend for food. In a land where such herds abound, it is only natural that lions and leopards should be both numerous and well fed

BIRD hunting in the lion country has much to recommend it as an exhilarating outdoor sport. Although I did not kill anything on the trip, I tried on one occasion to collect a few guinea fowl for the pot, but without success.

Mr. Clark and I were out looking for that elusive superlative male and a change of thought from lions seemed wise, so I went after a flock of guinea fowl traveling in Indian file, toward a kopje, a small tree-covered granite island that rose out of the level plain.

As is usual, the tender, young birds were in the lead and the tougher old ones in the rear, and the best I could do was to bounce a few shot from my twenty-gauge shotgun off the tough backs of the old birds as the line disappeared among the rocks, and then go in after them.

My mind was on the birds and I was not thinking of lions as I worked around one side of a small, high bowlder, but as I was about to pass a nice, sunny cleft in the rocks, I heard a tremendous "*whoof*" from around the corner—and then silence. I knew that I had not stepped on him, but doubted whether he was far enough off to allow me to swing my gun on him, if he charged. As I stood there waiting for something to happen, with nothing but the "whoof" to work on, I ruminated on the effect of a load of bird shot on a lion's disposition. Finally I decided that it was only a warning. I was not to disturb his dreams of fat zebra, and, having no further intention of doing so, I went on about my business of hunting guinea fowl. The hunting was all right, but just then I recalled that lions are said to come in fives, sevens, and elevens, so, not meeting any more birds and recalling the fact that they were vulturine guinea fowl anyway and

not very good for the pot, I worked back to the motor truck. There I expected to find Mr. Clark dozing at the wheel and the blacks dreaming of still more meat.

On the contrary they were recovering from what appeared to them to have been an unprovoked assault by a lion. I had so frightened the beast behind the rock that he had dashed downhill and out on the plain directly toward the car, which he did not see until he almost ran over it. Then, with a quick swerve, he shot past the rear end and was gone. Personally, I never did see that animal. He was decidedly jumpy and nervous for a lion, but perhaps he mistook me for Al Klein.

Lions are not afraid of cars, if they do not wind them and hear no human voices. They look at an approaching motor car very critically, but if the approach is skillfully made, they evidently decide that it must be an elephant; possibly a new sort of elephant with a rotary drive, but still an elephant, and so they let it go at that.

A lion is like an old-time gun fighter in our west. He is tremendously able to protect his interests. You can play with him, but not against him. Otherwise you will have to "blot" him, as Al Klein called it, and that spoils the wild-life picture for the next man. Africa without lions and leopards would be devitalized.

Lions add considerable zest to an afternoon stroll, as Mrs. Carlisle found one late afternoon when leaving camp alone for a constitutional on the plain below. Hardly had she started, when two shadowy lion forms passed close in front of her, bound for our camp water hole. They paid no attention to her, but they left a decided impression just the same.

On another occasion we passed through a group of six lions which were leaving the wooded river bed for an evening hunt. These lions were in a very different mood

FROM A MOTION PICTURE FILM

A very rare picture. The leopard is nocturnal and few motion pictures of uncontrolled and unafraid wild leopards have been taken

from those we had previously played with and photographed to our heart's content. They were hungry, hunting, and truculent, and no doubt would have given us trouble if we had troubled them, but we did not need any of them in our collection.

The following night, when near Victoria, we camped three hundred feet away from a closely-packed herd of some five thousand wildebeest, and I passed a wakeful night with their lowing in my ears and my mind occupied with the wilderness life around me.

With the first light I was up to see what I could read of the night's happenings. There were wildebeest closely packed as on the previous evening. Lions had taken their toll during the night, as was evident from the signs surrounding the herd. And then had come the hyenas and the jackals and the birds, and between them all there was nothing left of the kills but splotches on the grass. We saw seven hyenas slink toward cover in the dawn, with their mid-rib sections hanging low from their meals of wildebeest flesh and bones.

It is fortunate that hyenas are not killers and that they feed only after the lion and leopard, as there are many of them and they have jaws almost as powerful as a lion's.

THE object of our trip down the Blanketti River was to photograph buffalo, and although we secured some good pictures the animals were camera shy, and it was most difficult to drive them into the openings in the thorn bush where the light conditions were favorable. We finally gave it up, as this particular herd of about fifty was not truculent enough for our purpose.

As we neared Victoria Nyanza we

THE ETERNAL TRIANGLE

This lion was gazing wistfully at the two others—a male and a female. The evidence indicated that this was the preferred male, but that the other was older and stronger and had apparently driven this one away

A FINE CITIZEN OF TANGANYIKA
The opportunity to photograph a male lion in such a setting does not often occur

approached Wanyamwezi settlements and found the country alive with native hunting parties that were taking an incredible death toll of the wild herds there gathered. We passed dozens of groups that were killing wildebeest not for meat, but for their tails only, which they sell for three shillings apiece to the members of the Kavirondo tribe, bordering them on the north, who use them in their dance ceremonies.

Suddenly, when crossing a broad, grassy plain, between mountains, we came on a well-beaten human trail, the first we had seen in two months, and we followed it for several miles to its end. There we got a picture.

The Wanyamwezi were operating a game trap at the base of the mountain and were carving their kill into man-size sections for transportation to their villages near the lake.

Such game traps are village undertakings. Each family provides a line of nooses of about one hundred fifty feet in length, consisting of a single line lightly supported four feet from the ground. To this are fastened and hung single short lariats so arranged that each open noose touches the next.

The rope, about a quarter of an inch in diameter, is made from sansavera fibre found wild in the section. It is incredibly strong, stronger and softer than sisal fibre, and likely in time (when a decorticating machine is invented) to supercede it.

The method of operation is to group these many noose lines on an area of flat land near a hill along which it is easy to steer the game, and then the natives organize a great drive over the surrounding country. In this case the noosed area covered at least ten acres, and the result was a game trap as devilish in its effectiveness as any devised by the mind of man.

It caught practically everything that entered the area, whether they came in singles or hundreds.

Once an animal stampeded into the noose-covered area where the yellow ropes were the same color as the yellow grass, it had no alternative but to try and break through the maze, but few indeed succeed.

We saw tons of meat ready for transport. There were remnants of all the local animals from Thomson's gazelles to zebra, giraffe, and we even counted five striped unborn eland calves.

Such slaughter is supposed to be illegal, but game conservation in Tanganyika has not aroused the vital and growing interest that it has in America.

Also, this may have been the first game trap of this character seen by white men, and Al Klein and I debated as to whether we would spend some time in the vicinity in order to photograph the trap in action. We finally decided that the natives would postpone their next drive until we left the country, or, possibly, make us irresponsive to their affairs with poison arrows, so, as the light was unfavorable, and the pictures of the trap in action, if taken, were likely to be so bloody that they could not be shown to an American audience, we sadly left the scene.

We did no shooting, not even for meat, in that bit of country. We had no heart for it. My estimate of the animal life taken by all these native hunters from the surrounding country then filled with herds on their dry season migration is five hundred per day.

The success of an expedition to Africa depends largely on there being a similarity in the basic ideas of the members regarding killing. Those few who still enjoy the primitive and now out-of-date pleasure of killing animals on the decline, should not be members of parties composed of those who have risen above it. To my

INTERRUPTED
A fine specimen of bull buffalo photographed in the late afternoon when he had come out of a cool creek bed to feed

GIRAFFES ON THE SERANGETTI PLAINS

There are forty giraffes in this herd, but only a part of their number could be recorded by the motion picture camera. Good lion cover can be seen along a stream bed in the middle distance

joy, and rather to my surprise, I found that our able "white hunter," A. L. Klein, had progressed beyond this earlier conception of the subject, and we had some happy days photographing the animal life around us.

Al Klein is a great guide and hunter and also an expert at wild animal photography.

The combination of professional hunter and photographer found in Mr. Klein is rare indeed, and these qualities together with his high spirits, added to our pleasure and success.

Mr. Leigh's study paintings for the background of the lion group are very beautiful, and we are glad that he was selected to do the work. Seeing an artist go about his work with the purpose and concentration of a business man, losing neither time nor light opportunities, was a new experience to me.

If I were asked just what Mr. Raddatz performed as his major duty on the expedition, I would have to stop and think, for he covered a very wide field of usefulness. Mrs. Carlisle and I are grateful to Mr. Clark for making it possible for Mr. Raddatz to accompany us.

Of Mr. Clark's work on the lion group it might be unwise for me, as a layman, to express an opinion, but certainly Mrs. Carlisle and I are in entire sympathy with his conceptions as to design and color, and we look forward with keen anticipation to the completion of the group, which will be his and his associates' from the killing of the lions to the completion of the group on the exhibition floor.

An American mining engineer in Johannesburg, long active in the preservation of the game remaining in the Kruger National Park, rather demurred that we planned to do any killing at all. He has taken probably the greatest series of still photographs of African animals in the world, unless Al Klein has its equal, and he has never had to fire a shot.

I answered that as a conservationist I had considered his point of view and arrived at the conclusion that public interest in conservation can best be aroused by public exhibitions of such beauty and excellence as those being created in the American Museum. A few may properly be sacrificed for the good of the many.

Having acquired the rudiments of a scientific education myself, I desired that

the collecting should be done in the spirit of science and service and not in that of the hunter. I believe that a cut-over forest or a shot-over country has lost its bloom and can never be brought back. Although we all know that the wild life is going or gone, I, for one, do not wish to help push it over the brink. I believe that at least sample areas should be preserved, where the balance of nature is as it was in the beginning. It was not intended that man should completely cut the stream of animal life that has come down to us from the distant time that Professor Osborn portrays with such interest and accuracy, and this expedition was planned to collect with one hand and to preserve with the other. We represented a scientific institution and desired to act in accordance with the responsibility. In America the balance has been destroyed. Some species were exterminated and many nearly so from five to fifty years ago and now there is nothing better for us to do than to shoot and re-stock and repeat the operation down the years.

But Africa is different. There, with public interest and individual work, sample areas may and should be preserved, so that future generations can enjoy at least an unspoiled part of their entailed wild life estate, instead of the shadowy bankrupt heritage which is all that now promises to be theirs.

Vision and enlightenment must come to more men holding important and potentially influential positions for preserving the great picture of nature; and I am glad to realize that the American Museum and its representatives in the field are at the forefront of the wave of conservation that has swept America.

We look to all of our natural history museums in America to be effective agents for conservation both at home and in the field. They teach the beauty of nature, and, logically, the objective also is to inspire preservation of the beauties of nature.

WANYAMWEZI WOMEN AND CHILDREN
According to the local chief, the Carlisle party were the first white visitors ever to come to his village

Photograph by J. M. Johnson

"HE CLIMBED UPON A LOG AND RESTED IN THE SUN"

THE ODYSSEY OF A GROUND SQUIRREL

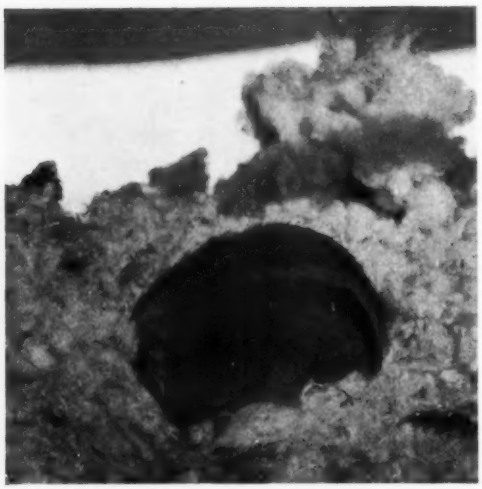
How, after a Winter of Hibernation, a Ground Squirrel Awoke in the Growing Warmth of Spring, How He Found His Mate, Raised His Family, and Met His Dramatic End

By ROBERT T. HATT
Assistant Curator, Mammals of the World, American Museum

In the following article Mr. Hatt, from his wide experience with rodents, has told the partially imaginary story of an individual golden mantled ground squirrel. Despite the fact, however, that the story is fiction, the reader may accept as absolutely accurate the information it contains, and can be assured that the impression he obtains of these appealing creatures is in every sense faithful to Nature.—The Editors.

THE golden mantled ground squirrel slept heavily. For five months he had been lying thus in his nest. The grassy ball that surrounded him lay at the foot of a short tunnel which he had dug in the crumbling granite high up on the mountain. His nose was held between his legs and his tail curled up over his head. In this way he formed a furry sphere that wasted little heat. Yet to the touch he was cold, insensible, and he was breathing so slowly that the movement of his sides was but faintly perceptible. Heart beats came far apart and seemed about to stop. His body was stiff as though it were paralyzed.

But somewhere near the center of this scarcely living ball must have appeared an uncomfortable sense of hunger, or possibly the self-made drug of sleep had become exhausted. A tremor ran through the numb circle of the little body from head to tail, and the tension lessened in its back. Then the shaking stopped and for an hour the creature remained nearly motionless. This stillness was broken when his head shook violently in all directions. The wakening proceeded slowly backward, affecting first the fore legs, then the trunk and rear legs. Eyes opened, and he stretched out, heavy-headed, dull-eyed. He tried to go to



"THE SQUIRREL SLEPT HEAVILY"

sleep again, but he was cold, and it was damp in his confined chamber. He turned round, and yawned, stretching out his upward curving tongue. Then each leg reached out, the toes spread wide with the exquisite tingling that follows long disuse.

An urge came to find food. In October, when last he had seen the sun, he had been rolling in fat. But now it was April and the fat had disappeared. After struggling to push through the side of his nest, he emerged into a tunnel leading to a storeroom. Here were a few frozen berries of the kinnikinnic that grew about his doorway, but nothing more. And here he nibbled a meager breakfast. Autumn's cornucopia had filled the mountain valleys with a wealth of seeds, but few of these were stored in the squirrel's storeroom. Sleep occupied so great a part of his winter season that the labor of storing up a hoard of food was not worth while. But autumn days spent basking in the sun must be paid for now by foraging outside, where there was little to find.

The tunnel was in bad repair. Freezing and thawing had caused sections of the roof to fall, and the awakened squirrel had to break these up and kick the gravel backward towards the nest in order to get out. It was fatiguing to work on an empty stomach, and the long-rested muscles soon grew sore. When he was about ready to give up from fatigue, the last crumbling rock gave way, and before him was a soft white mass that packed down easily with little pressing. Where earth walls ended and he had thought to enter open air, this soft, cold stuff still blocked the way. He pushed his nose into it and struggled on and upward. Soon his nose bumped a harder part, but here the light came strongly in. Excitedly scratching at the hard crust, he broke through into the bright sunshine on the mountainside.

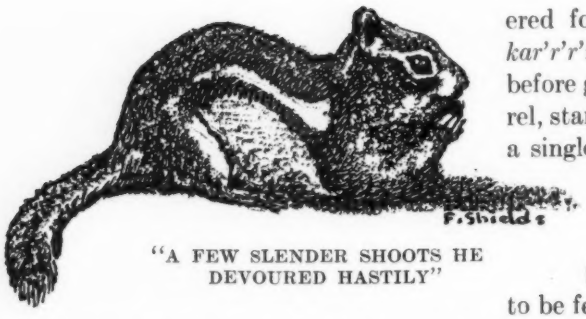
The fast melting snow lay deep in the hollows and under the trees, but here on the open, southward sloping hillside the ground showed great brown patches touched here and there with the delicate green of newly awakened life. From a

"SNOW WAS YET HEAVY ON THE UPPER SLOPES"

mountain torrent a hundred yards below, arose a roar that smothered every other sound. Squalling, long-crested jays hurled epithets at the brightly striped squirrel as he stood conspicuously on the snow, but because of the roaring water he could not hear them. A golden eagle screamed, poising before the breath-taking drop that might secure a meal for him. The squirrel did not hear the bird, but a rapidly moving shadow appeared near him on the snow. What caused the shadow he did not know, nor did he try to learn. Instead, he dropped abruptly back into the steep tunnel that his hind feet had never left, and a split second later a set of grasping hooks struck the soft snow that overlaid the crust. Such season's greetings from the air struck momentary terror into that timid rodent heart.

"WERE THEY GOOD TO EAT?"

But were the nervous systems of the grass-feeding multitudes subject to lasting fear, they would soon die of fright or of starvation. No wonder, then, that in a quarter of an hour a brown, short-furred nose appeared again just where the eagle had struck. Cautiously, with slow, short advances, and shorter, though quicker, retreating movements, the squirrel emerged again and, after surveying the sky and land, dashed over the edge of his small snow bank to the nearest patch of earth. This lay on the slope below a huge rock that caught the sun and that shunted off the wind pouring down the valley from the high peak that had not yet awakened to the spring. Already a few tender shoots of the first spring flowers were up and these he nipped and devoured hastily. The branch tips of a spruce brushed the ground near him and he saw the fresh and tender newly formed needles on the twigs. Were they good to eat? He'd try. Yes, when one is hungry they would do, but one soon tires of their strange flavor. There were no seeds about for this "beautiful seed-eater" (*Callospermophilus*, he was dubbed by scientists). All those that had not been



"A FEW SLENDER SHOOTS HE DEVOURED HASTILY"

picked up by the provident chipmunks, the pine squirrels, mice, and birds were now covered over by the movements of the surface soil. Such poor foraging! And being already fatigued, back he went to bed, where he slept for two weeks more.

Spring had come hastily to the mountain-side. The stream was still swollen to the proportions of a small river, for the snow was yet heavy on the upper slopes. But here about the burrow all the snow was gone, and ground patches that before were brown were now green and flecked with the white of blossoms.

The squirrel emerged slowly, with all his senses alert as was the custom and necessity of his kind. Once only in his life had he done otherwise, and then it was through the emergency door so well hidden by the matted bearberry. That time a weasel was close behind him and he did not have time to consider the terrors of the outside world when certain death was at his tail tip.

But on this day he came with caution. When his eyes were just above the level of the ground, he froze all motion and surveyed intently the hill and sky about him. There, on a little flooded meadow along the stream above, a deer was grazing, but that was not alarming. Deer, it was true, often stole the food about his doorway, but in themselves they were not a source of danger. If his eyes had been made far-sighted, he might have seen a small band of mountain sheep on the bare shoulder of the high ridge across the valley.

In the nearest spruce a gray and feathered form moved, and gave a rattling *kar'r'r'r kar'r'r'r* on seeing the squirrel, before gliding to a log near by. The squirrel, startled by the nutcracker, gave forth a single sharp, birdlike chirp. The note was not, however, intended conversationally. It was given in annoyance at being disturbed from a careful search for creatures to be feared. No alarming thing was to be seen, and no other ground squirrels were about. He came out and ran up to the top of the nearest bowlder. Here he was more exposed to attack, but it was a good point for observation and the sun felt warmer there. For a time he sat as motionless and upright as a stake upon the rock, but as all was tranquil, he settled down and assumed a sphinxlike attitude. An hour of basking made him comfortably warm. There was much to occupy his attention in this hour. The landscape he knew well, but moving, living things must be watched with care.

One thing the squirrel missed, and that was companionship. The others of his brood had disappeared. One had been taken on its first day outside by a lucky coyote. A brother had been

"HE RAN TO THE TOP OF THE NEAREST BOWLDER"

drowned in his burrow built too near the stream. Two others had moved three hundred yards up the valley to less crowded feeding grounds. In consequence he never again saw them. Was he the only one left of the lively company? He arose and ran down the surface of the rock to search for others. His hasty descent was checked rapidly, for there below him was another rodent, smaller, sharp-nosed, nervous, and heavily striped —a chipmunk, distant cousin of the squirrel. But, the nervous, jerky, little one fled, tail straight up, and the squirrel continued on his way. A trail, much used and quite well worn, hugged the base of a small overhanging bank, where from above the squirrel could not be seen, and this he followed. At one point a jutting root stub just brushed the backs of passing squirrels, though, should they choose, they could avoid it. This stub was, in their social world, a signal center, for each animal in touching it with its hair left a message on the stub. The vocal expressions of the ground squirrels are very few in number, so Nature has done the next best thing and has placed glands in the skin of their backs. From these comes forth a secretion that clings to the hair and gives off an odor strong to squirrel noses.

"THE NUTCRACKER GLIDED TO A LOG"

Our squirrel came to the stub and was arrested by the information which it bore. One scent stood out clearly over all the others. Some fellow squirrel had left that on the root not an hour before. The newcomer noted that the odor was that of a female and that she had been excited. Possibly the thing that had frightened her had by now caught and made a meal of her. More cautiously he moved forward, stopping once or twice to sniff the air and trail. As the wind was from his back it gave no warning of what lay before him, where, at a fallen log, the protecting bank stopped and he would be in the open. So, on he came, and was two feet from the protection of the rock when there came from what seemed to be a stump just at his right, a sharp "*woof*." The stump turned into a sitting bear that lunged at the squirrel, but by wheeling sharply and breaking into a mad burst of speed, he reached the protection of the overhanging rock, and dashed under the root stub, quite unconsciously leaving a light odor on it as he passed. In five seconds more he dove into his burrow. The bear arrived a moment later and tore furiously at the

Photograph by J. M. Johnson

"THERE BELOW HIM WAS A SHARP-NOSED SMALL CHIPMUNK"

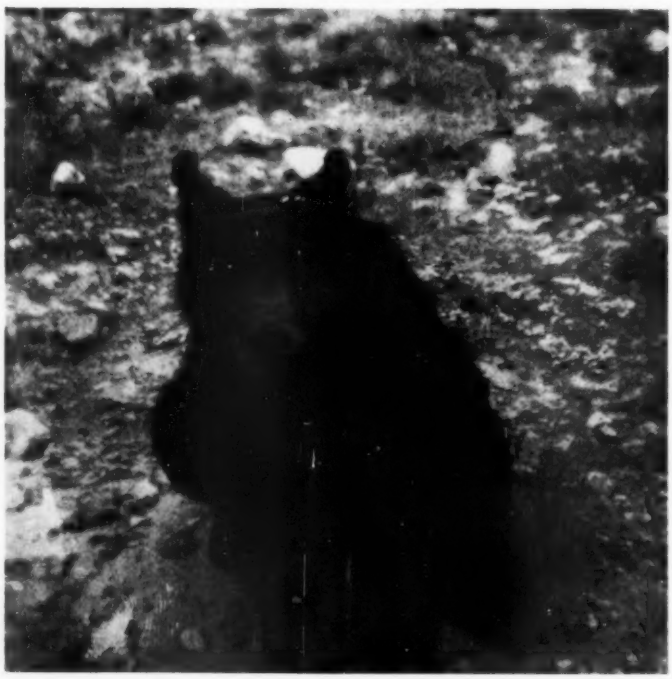
Photograph by A. E. Butler

"NATURE PLACED A GLAND IN THE SKIN OF THEIR BACKS"

burrow mouth while the squirrel trembled and uttered a high-pitched querulous whistle. By great good fortune the tunnel had been excavated in a softer filling between two solid rock masses and the bear could only scratch up the surface of the ground about the entrance. Unprofitable work, and so soon ended!

The spring wore on with one adventure crowding itself upon another. The hawks were an ever present source of concern, but spring had brought its pleasures, too. One day, the squirrel again found an odor on the stub where the squirrels left their messages. A strange quality in it excited him and drove him off in search of this member of his tribe, after he, in turn, had arched his back and rubbed it against the root. The morning of the following day he climbed up the slope to ground he had never visited, and there he came upon the object of his quest. She whistled in excitement, but stood her ground as he rushed toward her. He checked his impetuous run when he saw that she was not afraid. They came together and he nosed her sleek bright coat. But she broke away into a circling run. Pursuit ensued. Round and round they went in steeplechase. The race became a game. She let him come quite close, and then dashed away again. At last he stopped quite out of breath, and she started toward him, nosing the ground as she came, but turned and ran away again before she reached him. He pursued her even into her burrow. There they stopped and he adopted her dwelling as his own abode.

In the days that followed he had a new domain with which to familiarize himself. The tunnel had to be extended, an outpocketing made in which one could



"THE SITTING BEAR LUNGED AT THE SQUIRREL"

squeeze while the other passed. The nest was enlarged. Visitors arrived. The ever present fleas and mites were with them always, but now came ticks, and less annoying camel crickets, millepeds, book scorpions, and ants.

Later came four other warm, naked, blind, and squirming guests. Our squirrel became annoying to his mate, so, after a time, off he went and built another burrow near at hand. When the youngsters of the brood grew to such a size that they could venture out on long forays, their mother took them on a journey to a house down in the valley. Here the ground squirrels and the chipmunks were daily fed flapjacks and bread crusts, and all these creatures from the slopes about came to the repast.

From a Group in the A.M.N.H.

"THE YOUNGSTERS OF THE BROOD GREW TO A SIZE WHERE THEY COULD VENTURE OUT"

Many of the ground squirrels had learned to trust their human benefactress and took bits of food from her. The day the new brood came they found their father already there. At the moment he was driving away two chipmunks from a large slice of bread. When the smaller creatures fled, he seized the bread, and holding high his head, carried it away. A precipitous rock confronted him. He could, of course, have gone around. I do not know whether he was too stubborn or too stupid to do so, but instead of taking the easy route, up the rock he went. Head thrown far back, and arms stretched out, there was but trifling clearance for the load, but yet he could move onward. Three feet up, a jutting pebble stopped all progress; but the squirrel threw his head still farther back in an effort to clear the obstacle, and over he tumbled, backward down the rock, his booty released and rolling after him. But like Robert Bruce's spider, he at last succeeded and hid the plunder in a crevice at the top. With this feat accomplished, he returned to the feeding ground below.

At his approach a youngster in apprehension gave a whistle of alarm from his lookout on a woodpile. The others came to attention. Our squirrel rushed in and

"HERE THE GROUND SQUIRRELS WERE FED"

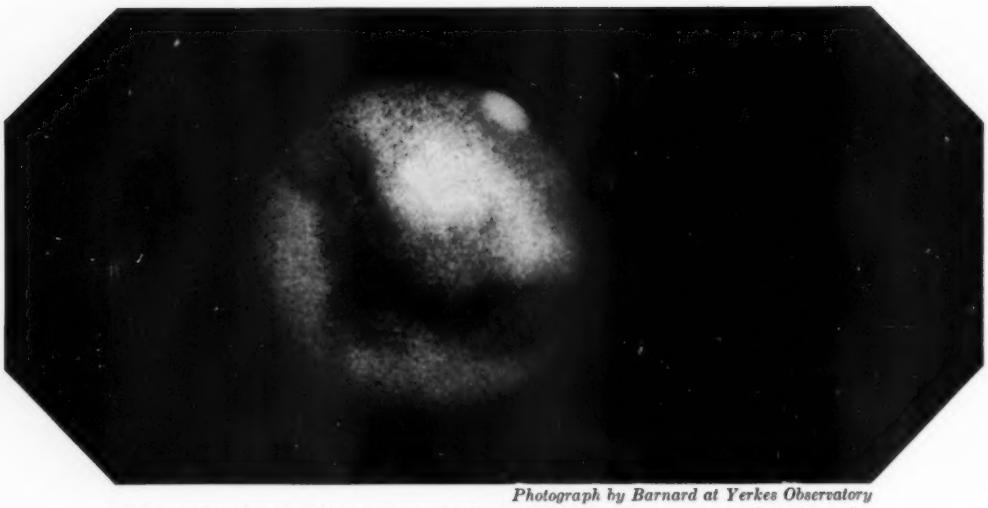
scattered them. An older, larger squirrel took offence and came up to him, nipped him on the flanks, boxed his ears, chased him out of sight up the slope, and came back to feed. Sulkily the punished little fellow climbed upon a log and rested in the sun. Spying the head of a big mullein stalk near the other end of the log, he got up and ran down to a point where the fine head could be reached. He extended a graceful hand and pulled it in, cut off the seed-bearing section and cleared it as a chickaree would a pine cone. Delicious were these still juicy seeds. The Oregon grapes were hardly better. He was too occupied to notice that the little

"HE THREW BACK HIS HEAD"

"A YOUNGSTER GAVE A WHISTLE OF ALARM"

birds about had become silent, too busy to see that over him circled a hawk. The hawk circled twice to get the best position for the plunge. Then with wings half folded, feet stretched out, talons held tense, rocket-like the hawk plunged, using his wings only enough to steady his aim and to break the force of his final impact. The squirrel felt a rush of wind, and that was all. Two strong feet encircled him, eight piercing claws sunk deep and did their work. The hawk turned, crouched down, and with a powerful first beat of his wings, lifted himself into the air and sailed away down the valley to his feeding tree.

"TWO STRONG FEET ENCIRCLED HIM"



Photograph by Barnard at Yerkes Observatory

Mars, showing south polar cap (top), and *Syrtis Major*, the wedge-shaped extension of the darker belt toward the north

THE RUDDY WANDERER OF THE SKY

The Planet That Has Most Interested the Inquiring and the Imaginative Mind of Man

By CLYDE FISHER
Curator of Astronomy, American Museum

"There is no light in earth or heaven
But the cold light of stars;
And the first watch of night is given
To the red planet Mars."

—Longfellow

CONSPICUOUS in the spring (1929) sky, a little southwest of the point directly overhead at eight o'clock in the evening on March first, is a planet that looks like a red star of the first magnitude, but it shines with perhaps a more steady light. It is Mars, the most interesting of the planets,—fascinating to the astronomer because of the many conditions that approach those on the earth and the perplexity he has encountered in studying them,—intriguing to the layman because of the perennial question of possible inhabitants.

Its orbit is next outside that of the earth, and at times it approaches almost as near our planet as does Venus, whose orbit is next inside. Venus when at inferior conjunction, that is, when on line between us and the sun, is within 26,000,000 miles of the earth. Mars at a favorable opposition, that is, when on line opposite us from the sun, may approach as near as 34,600,000 miles from the earth. The last close approach of Mars was in August, 1924.

At an average conjunction, that is, when on the opposite side of the sun from the earth, Mars is 234,400,000 miles from us, is only about half again as bright as the North Star, and might readily be mistaken for a red fixed star did not its motion betray its true character. At a favorable opposition it is more than fifty times as bright as at conjunction, and surpasses Jupiter in splendor, being brighter than any other planet except Venus.

The diameter of Mars is 4200 miles, or a

little more than half that of the earth. It requires 687 of our days for Mars to make one trip around the sun. It is a striking coincidence that Mars rotates on its axis in almost exactly the same time required by the earth. Another surprising coincidence is that the axis of Mars is inclined almost exactly the same as that of the earth. Due to the last-mentioned condition, there must be seasonal changes on Mars similar to those on the earth.

Two tiny moons attend the planet, having been discovered at the favorable opposition of 1877 by Prof. Asaph Hall, then an astronomer at the United States Naval Observatory. Their names Deimos and Phobos, are those used by Homer for the fiery steeds which drew the chariot of the god of war. They are the smallest known bodies in the solar system except the meteors and possibly the smaller asteroids. Deimos occupies a little more than 30 hours in making one revolution and is 14,600 miles from the planet's surface. Its diameter is estimated at about five miles. Phobos, the inner moon, is only 5286 miles from the surface of Mars, and is estimated to be about ten miles in diameter. It makes a complete revolution in 7 hours and 39 minutes, which is less than one third of the planet's day. Phobos is the only known moon which makes the trip around its primary in less time than the primary takes to turn once on its axis. In consequence of this unusual speed it rises in the west and sets in the east.

These small moons can be seen only with very large telescopes and when Mars is at or near opposition. They have been photographed at the Lowell Observatory at Flagstaff, Arizona, by Mr. E. C. Slipher, who has made many of the finest planetary photographs ever secured. According to Professor Lowell, neither of these

MARS IN CRESCENT PHASE AS SEEN FROM PHOBOS

An imaginative drawing of Mars as it would appear from its inner moon which is just a little more than 5000 miles distant. From a drawing by Howard Russell Butler, N. A.

MARS IN GIBBOUS PHASE AS SEEN FROM PHOBOS
To an observer on Phobos, the inner satellite of Mars, the planet would go through this phase. The polar caps and other surface details should be easily made out. From a drawing by Howard Russell Butler, N. A.

satellites shares the ruddy color of the planet.

Professor Howe has pointed out that the discovery of these satellites was curiously anicipated by Kepler, Dean Swift, and Voltaire. One of Kepler's strange speculations, which he mentioned in a letter to Galileo, was that Mars had two moons, Saturn six or eight, while Mercury and Venus were possibly blessed by a single attendant each. Dean Swift represents in *Gulliver's Travels* that the scientific Lilliputians had telescopes of great power, with which they had discovered "two lesser stars or satellites which revolve about Mars." Voltaire makes a hypothetical inhabitant of Sirius take a celestial voyage, in the course of which he visits Mars and sees two moons that are intended to make up for the comparative feebleness of the sunlight.

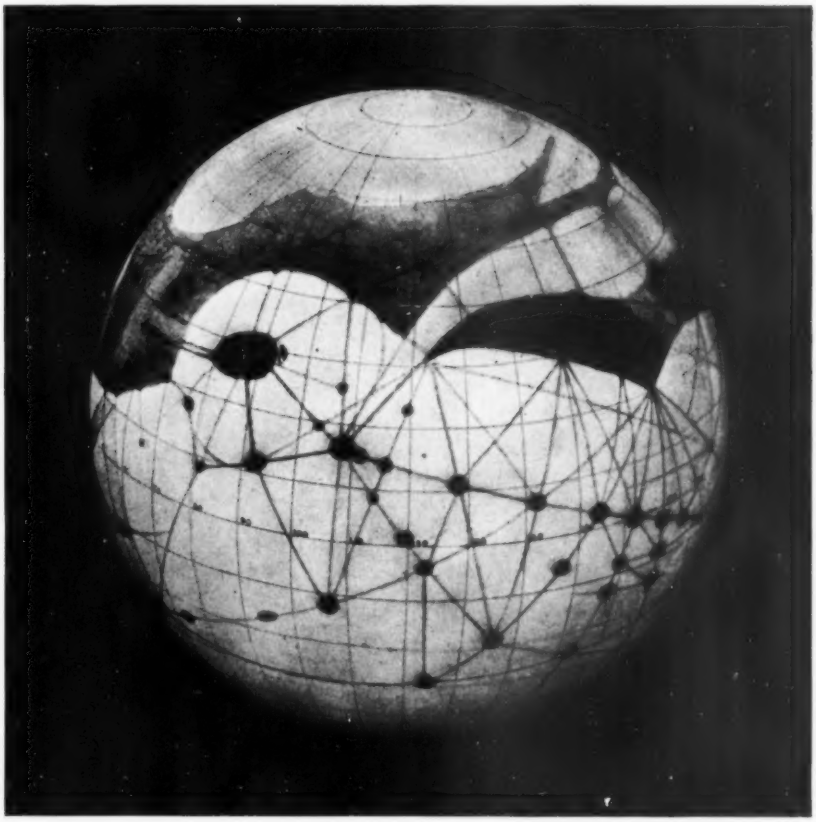
Like all the planets and all their satellites, Mars shines only by reflected sunlight. This fact, together with the movement of Mars and the earth in revolution, causes Mars to go through changes of phase, but not so great as those of Mercury and Venus, the two planets inside the earth's orbit. At opposition, when the earth is between the sun and Mars, the latter shows a full, round disc; at conjunction, when Mars is on the opposite side of the sun from the earth, it has the same phase, but at intermediate times we cannot see all of the bright hemisphere, that is, Mars is in a gibbous phase. However, as seen from the earth, Mars never exhibits a crescent phase, as Mercury and Venus do.

The planet is a beautiful object through even a small telescope, the disc, as a whole, being reddish or orange-colored, with diversified light and dark markings. The darker regions of "a bluish-gray or greenish shade" are mainly confined to a very

irregular belt around the tropical regions of the planet. During a single night it is quite easy to observe the rotation of Mars on its axis by noting the change in position of some easily recognized feature such as *Syrtis Major*, the wedge-shaped extension toward the north of the dark belt. (See p. 194.) These darker areas were long supposed to be sheets of water,—and the adopted names derived from classical sources were based on this theory,—but now it is practically certain that they are not water. If they were water, it is believed that the sunlight would be more brilliantly reflected than it is, and that the darker regions would be more uniform in tone than they are, that is, that they would exhibit less conspicuous detail. On two occasions Professor Lowell saw the *Mare Erythræum* "change from blue-green to chocolate-brown shortly after the winter solstice, and return gradually to its former tone as spring approached."

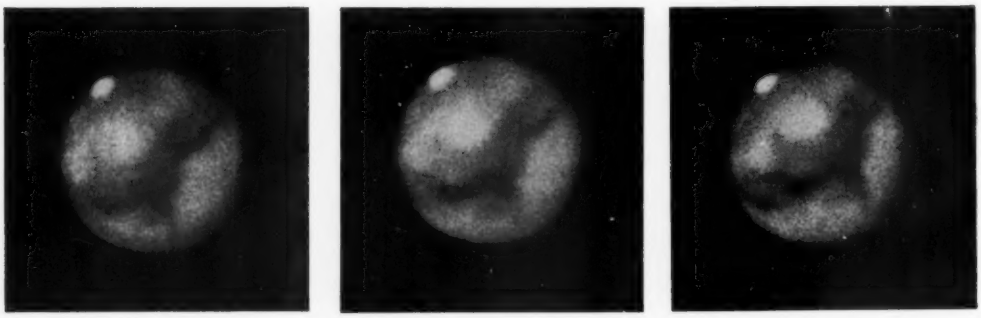
The reddish portions of the surface do not change with the seasons, and it is thought that they are the bare and almost smooth surface of the planet, upon which the other markings are to be seen.

The polar caps, which were seen soon after the invention of the telescope, have been observed ever since as conspicuous features on the surface of Mars. These polar caps change in size with the Martian seasons just as those of the earth do. When Mars is at winter solstice for the northern latitudes, the north polar cap is very large, often extending halfway to the equator. A little before the spring equinox for the northern hemisphere of Mars, the cap begins to shrink, and does so until late summer, when it becomes as small sometimes as two hundred miles

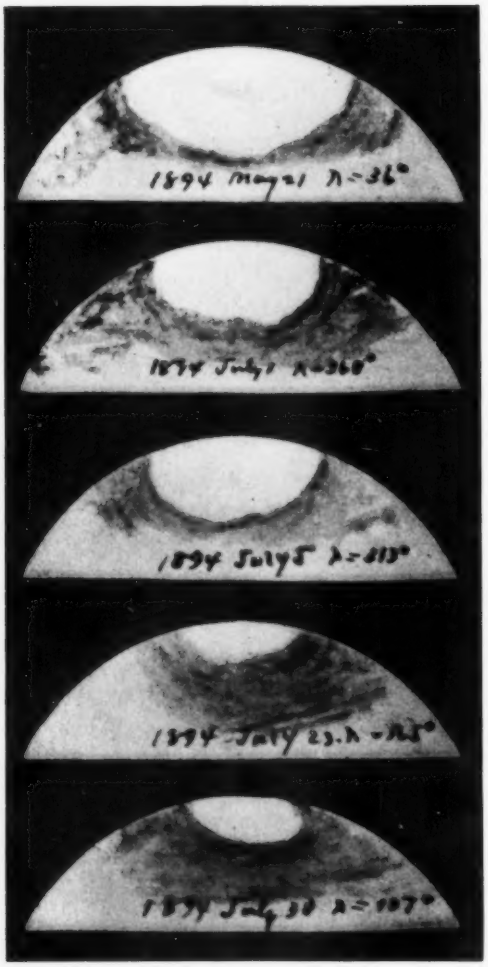


CANALS ON MARS

At the Lowell Observatory, Flagstaff, Arizona, is a series of globes upon which drawings of Mars were made by the late Percival Lowell, who believed the lines indicated the existence of irrigating canals which carry the water produced by the polar snows to every part of the planet. Note the south polar cap at the top of the picture



MARS ROTATES ON ITS AXIS
The photograph on the right was made first, the one in the middle second, and the one on the left last,—and all three were made within an hour and a half, yet a comparison of the position of *Syrtis Major*, the wedge-shaped projection of the dark belt toward the north (bottom), shows that Mars rotates on its axis. Photographs by Barnard at Yerkes Observatory



THE MARTIAN POLAR CAP SHRINKS AS SUMMER APPROACHES
Drawings of the south polar cap of Mars, made by Barnard through the 36-inch Lick telescope, showing how this cap decreased in size from May 21 to July 30, 1894. The polar caps on the earth behave in exactly the same way

in diameter. Similar changes are observed in the southern polar cap, but the shrinking is greater, for at least twice the southern polar cap has completely disappeared toward the end of summer. Although it has been suggested that these polar caps may be solid carbon dioxide, it is now quite generally believed that they are composed of snow and ice, that is, frozen water. Carbon dioxide volatilizes, at low pressures as exist on Mars, at temperatures much lower than those measured for the polar caps, as pointed out by Professor Russell and his associates.

The so-called canals, as they were called by Schiaparelli fifty years ago, have been perhaps the most puzzling feature of the planet. There are many narrow, dark, straight lines crossing the ruddy portions of the disk. No doubt such markings exist, but the drawings and descriptions by various astronomers disagree surprisingly. Professor Lowell observed and mapped more than four hundred canals, which formed a complex network of geometrical precision over both the ruddy and darker regions. From four to as many as fourteen canals come together at one point, usually a dark spot called an oasis. Some fifty of the canals he observed to be

By Courtesy of the Illustrated London News

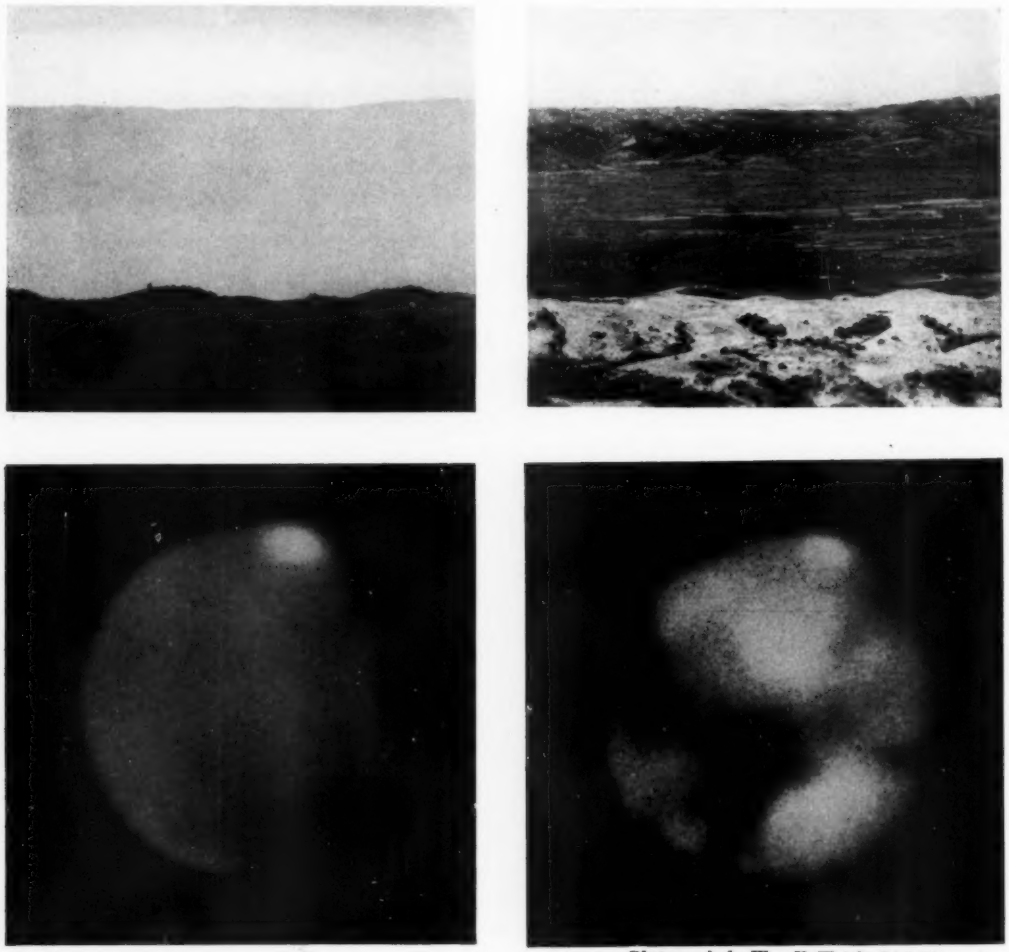
MARTIAN SCENERY: A THEORETICAL VIEW OF THE EDGE OF A "CANAL" WITH A DISTANT SANDSTORM

The markings on Mars, which appear as dark lines from the earth, whether natural or artificial in origin, are supposed to be strips of vegetation bordering streams, with perhaps a Moroccan type of climate. The actual canals would be too narrow to be visible to us. Drawn by Scriven Bolton

double. To be visible from the earth with the large telescopes, it is estimated that these canals must be at least fifteen miles wide, and Lowell thought them to be not more than twenty miles wide at most.

On the other hand, most of our astronomers have never been able to see this elaborate system of narrow geometrical markings, but intermediate positions from Lowell's to a practical denial of the existence of these markings are held. Although the coarser features of Mars can be photographed, the canals cannot,—therefore the problem cannot now be solved by the photographic plate. The prevailing theory is that these markings are waterways bordered by vegetation, as suggested by Prof. W. H. Pickering. The valley of the Nile would appear much the same to an observer on our moon,—a green streak across the African desert.

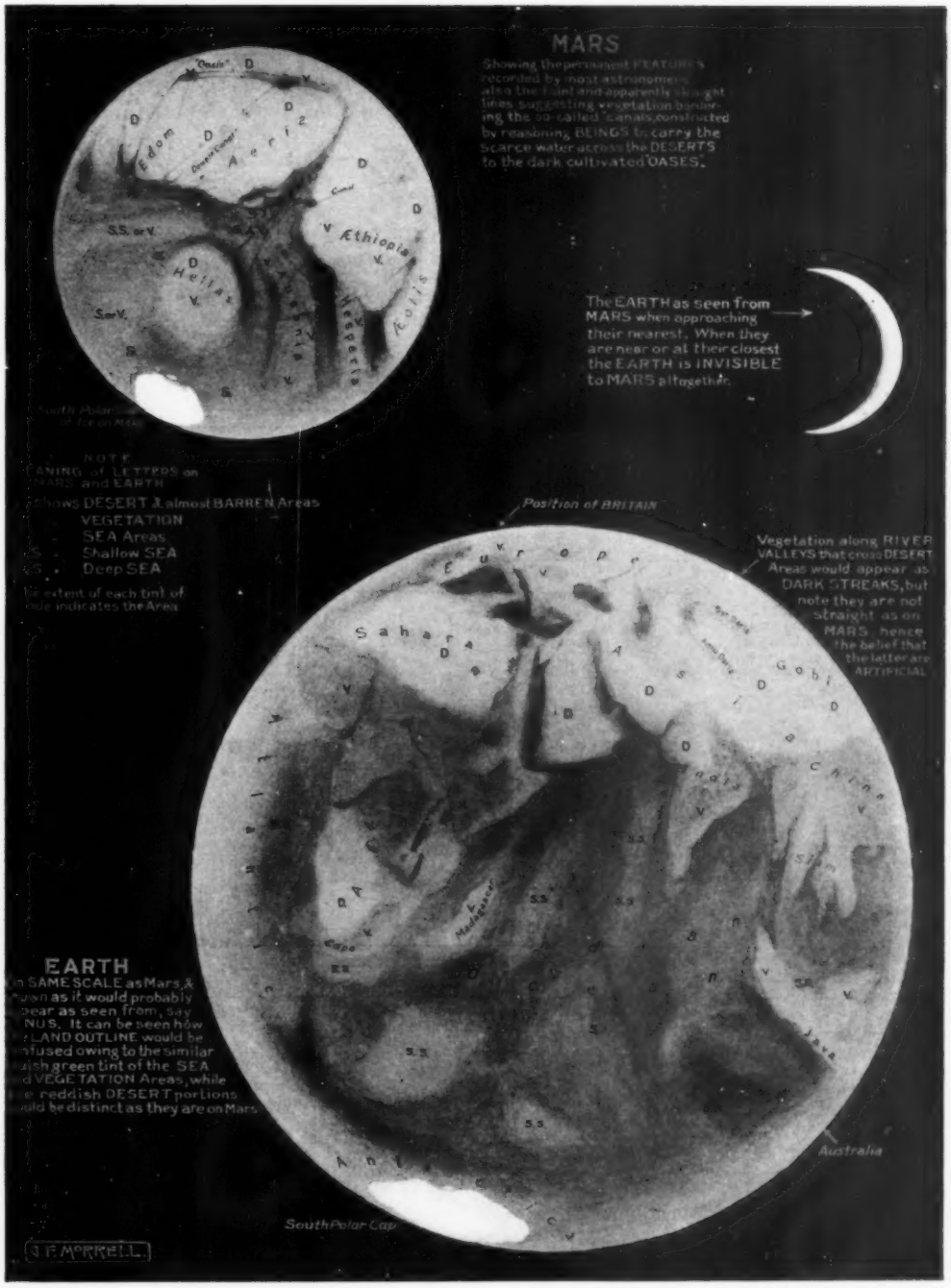
The question of most widespread interest concerning Mars is whether life exists there. The possibility and the



Photographs by Wm. H. Wright, Lick Observatory

MARS AND SAN JOSÉ AS PHOTOGRAPHED FROM MT. HAMILTON, CALIFORNIA

The two photographs at the left were photographed with violet light, and the two at the right with infra-red light. The obscuration in the upper left is due to the earth's atmosphere, and the comparison is suggestive of the presence of an atmosphere of considerable density on Mars. San José is 13½ miles distant from Mt. Hamilton



Courtesy N. Y. Public Library

MARS AND EARTH COMPARED

A drawing of Mars compared with an imaginary view of the earth as it would probably appear from, say Venus. The difficulty of making out definite outlines is evident. When the earth and Mars are closest together, the earth would be invisible from Mars, because the unlighted or night-side of the earth would be turned toward our ruddy neighbor. Drawing by G. F. Morrell

AS H. G. WELLS IMAGINES THE MARTIAN JUNGLE TO BE

"A jungle of big, slender, stalky, lax-textured, flood-fed plants with a sort of insect life fluttering amidst the vegetation." Drawn by William R. Leigh for "The Things That Live on Mars," by H. G. Wells, *Cosmopolitan Magazine*, 1908

probability of life depend upon conditions.

First, there is no doubt that Mars has an *atmosphere*, although probably much less dense than on the earth. If it were as dense as that of the earth we could not see the polar caps so distinctly. The polar caps themselves are pretty surely the precipitation of some substance previously held in suspension as vapor in an atmosphere. When Mars is in the gibbous phase, the sunlit portion encroaches on the dark part, only explainable as due to atmosphere. Mars is brighter near the edge than in the center, since we are looking obliquely through a greater thickness of atmosphere and this reflects more light. Although rare, clouds have been observed and photographed on Mars.

The spectroscope shows that there are *oxygen* and *water vapor* in the Martian atmosphere, although in smaller proportions than in the earth's atmosphere.

Although colder than on the earth, the *temperatures* do not preclude the possibility of life. The temperature rises well above freezing at noon in the equatorial

MARTIAN ANIMAL LIFE AS CONCEIVED BY MR. WELLS

"The same reason that will make the vegetation laxer and flimsier will make the forms of the Martian animal kingdom laxer and flimsier and either larger or else slenderer than earthly types." Drawn by William R. Leigh for "The Things That Live on Mars," by H. G. Wells, *Cosmopolitan Magazine*, 1908

regions, and may reach or exceed 50 degrees Fahrenheit.

Water is present as vapor in the atmosphere, as snow in the polar caps, and probably as liquid in the regions between the polar caps. However, it is believed that desert conditions prevail over a great portion of the surface of the planet Mars.

With these conditions established, it is very probable,—but not surely proved,—that there is life on Mars; very probably plant life—possibly animal life as well. Professor Lowell maintained that there are intelligent beings on Mars, evident from the engineering skill necessary to construct the intricate system of canals which he considered a great irrigation enterprise, but his whole theory rests upon conclusions that are not generally accepted by astronomers.

No careful scientist would deny the existence of intelligent beings on Mars, but most will want more evidence before coming to a positive conclusion concerning the question.

Drawn by Warwick Goble

ANOTHER OF MR. WELLS'S IMAGINARY MARTIANS

This octopus-like creature is one of the highly intelligent Martians, who, in H. G. Wells's novel *The War of the Worlds*, invade the earth, and for a time terrorize England, where the story is laid. There is, of course, no evidence to suggest that such creatures live on Mars. This novel first appeared in the *Cosmopolitan Magazine* in 1897

IMAGINARY INHABITANTS OF MARS, ACCORDING TO MR. WELLS

"There are certain features in which they are likely to resemble us, and as likely as not they will be covered with feathers or fur. It is no less reasonable to suppose, instead of a hand, a group of tentacles or proboscis-like organs." Drawn by William R. Leigh for "The Things That Live on Mars," by H. G. Wells, *Cosmopolitan Magazine*, 1908

Courtesy of the N. Y. Zool. Soc.

ECHIDNA, THE SPINY ANTEATER
Note the peculiar, long, recurved claw on the hind foot

STRANGE ANIMALS OF THE ISLAND CONTINENT

The Second of Two Articles Descriptive of the Many Unique Animals of the Australian Region

By H. C. RAVEN
Associate Curator, Comparative and Human Anatomy, American Museum

AMONG the many unique animals of the Australian region with which I have come in contact in the field, few are more interesting than the echidna (*Tachyglossus*). These spiny creatures, while they are rare enough on the mainland of Australia, are comparatively common in southwestern Tasmania, and I consequently expected little trouble in studying and collecting them there. That, however, was before I had a great deal of first-hand information about the ability of echidnas to hide. If one should set down a full grown echidna on a smoothly clipped lawn, it would take the animal only a short time, were he so inclined, to dig a hole straight down quite large enough to shield him from inquisitive eyes, for as an echidna digs down, the earth falls in over him. A few square inches of prickly spines might still protrude slightly above the ground level—spines which, while not barbed, as are those of the American porcupine, are quite sturdy and sharp enough to protect him from rough handling. Or, with a little more time, he might well burrow completely out of sight in a hurriedly dug hole slanting slightly from the perpendicular.

With such ability to bury himself, it can readily be seen that the echidna is not one of the simplest creatures to find when one is hunting for him in more or less wild country, where tufts of grass, irregularities of the earth's surface, bushes, fallen trees, et cetera, all tend to aid him in his desire to escape detection. The result was that I had very little luck indeed, and the echidnas I saw were very few and far between.

By great good fortune, however, I met a prospector who was thoroughly familiar with the country and its wild citizens. In a talk with him I told him of my difficulties, and he assured me that my troubles were over. He had a dog, he announced, that was especially interested in the pursuit of echidnas. What the dog's idea was in such a hobby I cannot imagine, for once he located them he usually damaged his nose and paws on their spines, for echidna spines are notoriously hard on

inquisitive dogs. However, I was less interested in the dog's reasons for his interest than in his efficiency in locating the creatures, and I asked to see the beast.

I was introduced to a thoroughly mongrel creature that had all the friendliness of the average mongrel, and after a tryout, in which the dog promptly located an echidna and barked madly while I captured it, I purchased the "echidna hound" from his master. From that moment on my luck changed for the better, and echidnas no longer presented the problem that had troubled me before.

An adult echidna is likely to be in the neighborhood of sixteen or eighteen inches in length. It is thickly covered with short, heavy spines that normally lie slanting backward. When the animal is frightened, however, these spines stand much more nearly perpendicular, and present a phalanx of spear points that demand respect. Growing thickly between these spines is the creature's hair, the longer portions of which are stiff, while underneath is some very soft fur. The animals are subject to considerable variation in color, but the variation limits itself to shades of brown.

The spines are much shorter in proportion to their diameter than are the quills of a porcupine, and they are not barbed. Furthermore, they are attached quite firmly to the animal's back, and do not come out when they impale an object, as porcupine quills do. They are two inches, or a little more, in length, and at their bases may measure as much as a quarter of an inch in diameter.

The animal's nose is long and thin, ending in two tiny nostrils and a mouth which, when opened to its greatest extent, is hardly more than a quarter of an inch in diameter. There are no teeth within this cavity, and the long tongue, which may be extended from two to three inches beyond the end of the nose, is supplied with a mucilaginous substance from large salivary glands, thus making the tongue a sort of natural strip of sticky fly paper.

The forefeet of the echidna are armed with very powerful claws, and with these

Courtesy of the N. Y. Zool. Soc.

THE PLATYPUS
(*Ornithorhynchus anatinus*)
This is the strangest of Australian mammals and the most primitive. Superimposed on its lowly heritage are many striking specializations for an aquatic life, to wit: short legs, large webbed feet, a flattened beaver-like tail, dense fur, and a ducklike snout

the little animal can tear apart the rotted and porous logs inhabited by the insects, the larval insects, the grubs and worms that make up its diet. Once the claws have made an opening in a log inhabited by a colony of termites, for instance, the thin, sticky tongue darts out and explores the numerous passages cut by the termites through the wood. The unfortunate residents of that raided colony then find themselves stuck to the rapidly moving tongue, whereupon they are drawn into the mouth of the echidna and crushed between a rough pad that forms the back part of the tongue and a series of horny spines that grow, in lieu of teeth, from its palate.

To see one of these animals wandering slowly across an open place, when it has not been disturbed, is instantly to be reminded of nothing less than a tiny elephant, for its long nose, pointing toward the ground, has a most humorous resemblance to an elephant's trunk, and its body and short neck appear, at a distance, to be more or less the same in proportion as those of an elephant. Disturb it, however, even ever so slightly, and it changes its appearance utterly. It tucks its nose safely underneath. It sinks down on its short legs. It erects its spines, and lies still, having now become almost turtle-like in shape.

These animals do not bring forth their young alive, but following the methods of birds and reptiles, lay eggs. Only one egg is produced at a time, and this, which is about ⅝ of an inch in diameter, white, and more or less spherical, resembles a turtle's egg more than anything else, its shell being leathery and tough. As is the case with so many Australian animals, the female echidna has a pouch, and in this the egg is carried, and, thus protected, the baby echidna is hatched. Nor is the new arrival thrust out into the cold world until, his spines beginning to develop, he makes it too uncomfortable for his mother.

For a time I occupied a shack in a lumber camp in northwestern Tasmania, and kept an echidna as a pet. He lived in the board-floored place for some time, and, after I had thrust his nose into teaspoonfuls of milk several times, he learned to accept this new food. The room was not plastered, and I found, before long, that the little fellow could climb very well indeed. On one occasion I saw him waddle to the corner of the room, cling with his claws to the inequalities of the inside of the clapboards, and mount slowly to the very ceiling. He clung there for a time and then, quite abruptly, fell to the floor with a thump. He lay still for a minute and then ambled off, none the worse.

Occasionally I took him out and placed him on some insect-infected log, whereupon, with no hesitation, he would tear it open and search out the insects with his long, sticky tongue. If I picked him up he would promptly curl up defensively, but after a time, if I handled him gently, he would uncurl, and struggle mildly to escape. During the cold weather he loved to approach the fireplace and lie on his back before the blaze, soaking up the heat.

The fore claws of this animal are the more powerful, but each of the hind feet is equipped with an extraordinary instrument as well. As can be seen from the photograph of the echidna at the head of this article, one claw on the hind foot is exceptionally long, and curves out in a truly remarkable fashion. This is useful when the animal is burrowing in the ground, and is then used to push the loose dirt out of the way. Its greatest value, however, seems to lie in the fact that it is long enough to be inserted between the spines and used as a back-scratcher. I have often seen my pet echidna thrust that long claw in between the spines on his back, and scratch himself with what seemed to be the greatest satisfaction.

The echidnas of the Australian mainland have more spines and less hair than those that live in the colder climate of

Courtesy of the N. Y. Zool Soc.

THE RABBIT-BANDICOOT

One of the rarer and more specialized bandicoots. Its pelage is soft, and in color pearly gray and white, with some black on the basal part of its tail. Its hind feet are elongate, resembling those of the kangaroos

Tasmania, but aside from that there are only minor differences. There is a related animal, however—the proechidna (*Zaglossus*)—that is about twice the size of the echidna. It lives only in New Guinea at present, although some remains of the animal have been found in the Pleistocene deposits of Australia. It has longer legs than its Tasmanian and Australian cousins, has fewer spines, and a very much longer snout. Its habits, however, are somewhat similar to those of the echidna.

Another Australian animal that is as unique as the echidna, and is, perhaps, even more intriguing to the average person, is the duck-billed platypus (*Ornithorhynchus anatinus*). It lives in streams and ponds where it feeds on larval insects and the various invertebrate and perhaps vegetable life that it finds in the mud and sediments at the bottom.

The largest platypus lives in Tasmania and attains a length of about two feet. The smallest is found in tropical North Queensland, where it is not likely to grow to a length of more than eighteen inches. As everyone knows, it has a bill remarkably similar, superficially, to that of a duck. The bill is broader and heavier, it is true, but its shape is not greatly different, and the creature's mouth, too, is ridged more or less as is a duck's.

In addition to possessing a ducklike bill, the animal has webbed feet. In this case it actually outdoes the duck, for the web extends beyond the claws, although, when the platypus wants to use its claws, the web can be folded back, leaving the claws exposed.

The platypus feeds in a manner closely resembling that of certain wild ducks, in that it dives to the bottom, secures a mouthful of material, and comes to the surface, where it washes the mud and other matter out before swallowing the food. If one should add to this that the creature lays eggs, one realizes what an amazing parallel this is.

Actually, of course, the platypus is a mammal with a coat of heavy, dark brown fur. As with the beaver, the outer coat is coarse, while underneath there is a coat that is very soft and heavy. The animal's tail, also, is beaver-like in shape

Courtesy of the N. Y. Zool. Soc.

THE TASMANIAN DEVIL

An ungainly carnivorous marsupial, whose head is extremely large and powerful, but whose brain is not much larger than that of a rabbit

—that is, it is broad and flat and rather heavy—but, unlike the beaver, the tail is covered with coarse hair, although on the underside the hair is very short.

The platypus does not have a pouch, and it lives in tunnels dug in the banks of streams or ponds. The entrances to these are about at normal water level, but the tunnel tends to rise at an angle until the end of the burrow—where the nest is built—is only a little distance under ground. This is probably done in order that the air may penetrate the ground to the nest.

The nest itself is made of grass roots, leaves, or twigs, of bits of bark, and other material that might be found floating in a stream or stranded along the bank. Here two eggs, attached to each other, are deposited—like those of the echidna, these are covered with white and leathery shells—and from them two platypusses are hatched. Being mammals, the baby platypusses live on milk, yet the mother has no teats. Instead, the milk oozes from special pores in the skin, and adheres to the mother's fur, from which the babies obtain it.

Because these animals live in the water and under the banks of streams, they are not caught readily. I have, however, occasionally caught them alive, and though the males are armed with short sharp spurs on the inside of their hind feet, through which run ducts supplied with poison from poison glands situated on the backs of the thighs, I have never had one of them attempt to use his spurs on me. The actual use of these spurs is not thoroughly understood, nor is much known about the strength of the poison. From my experience with platypusses, it would seem that they do not inflict poison wounds consciously.

As is the case with creatures adapted to aquatic life, such as beavers, crocodiles, and hippopotami, the platypus has its ears, its eyes, and its nostrils all situated on the upper part of its head and nose. Thus with a minimum of exposure above the surface of the water, it can hear, smell, and see. One can guess from this how difficult these animals are to capture.

There are many other animals in Australia that are strange and unreal to the inhabitant of other portions of the world. Among these the rabbit bandicoot should

not be overlooked. It is a creature about the size of a large cotton-tail rabbit, and although it, too, is called a *rabbit* bandicoot, it is not a rabbit at all. Its Latin name, *Thalacomys lagotis*, might be translated "pouched mouse with ears like a rabbit." Its long ears are somewhat rabbit-like. Its nose is decidedly like that of a shrew, but except for these superficial resemblances, it is decidedly a marsupial.

It is a pouched animal, that brings forth from four to six young, each of which, at birth, is about three quarters of an inch in length. As is the case with all pouched animals, the young are born when very much underdeveloped, and they live in the pouch until they are able to hop along with the mother. This mother, however, travels on all fours, unlike the kangaroo, and the pouch is ingeniously turned around so that the entrance is toward the rear, thus keeping twigs and other foreign matter from sticking into the pouch when the mother is walking or running.

Until the young are about the size of large rats they live in the pouch, but then they are turned out, although they often stay with their mother for months—sometimes as much as a year. They live in the dry country of Australia, although they are not desert dwellers. Their burrows are dug in the plains, and their food is made up of grubs that they obtain from about the roots of plants, and from vegetable matter as well. Their fur is a beautiful pearly gray, and their tails are tipped with white, although most of that appendage is black.

The Tasmanian devil (*Sarcophilus ursinus*), on the other hand, is a carnivorous animal, limited, now, to Tasmania. It is not greatly different in size from the American badger, but its head is very large in proportion to its body. It is an eater of carrion, but is perfectly willing to attack any animal that is not too large. It is even said that, formerly, when these "devils" were more numerous, they would enter sheep pens and kill sheep.

I was out one night looking over some traps and had with me a dog that normally

Courtesy of the N. Y. Zool. Soc.

THE WOMBAT

A robust bearlike vegetarian that spends its days resting in long deep tunnels of its own making. At night it wanders about searching for leaves and roots of various grasses and shrubs

seemed able enough to care for himself, when I was suddenly startled by a series of frightful wails not greatly unlike those of a cat. The dog appeared from nowhere in the dark and stood tightly against my leg, the bristles on his back erect, and his legs quivering with fear. Investigation showed that two very lively and indignant Tasmanian devils were caught in two traps that were near each other, and although the dog had not been harmed, he certainly showed no inclination to attack the animals. As soon as I drew near the captives, however, they ceased their caterwauling, and did nothing except open their mouths and hiss in a manner not greatly different from that of an American opossum. I picked them up by their tails and carried them to camp, and although they protested a little, their protestations were so mild as to make no trouble.

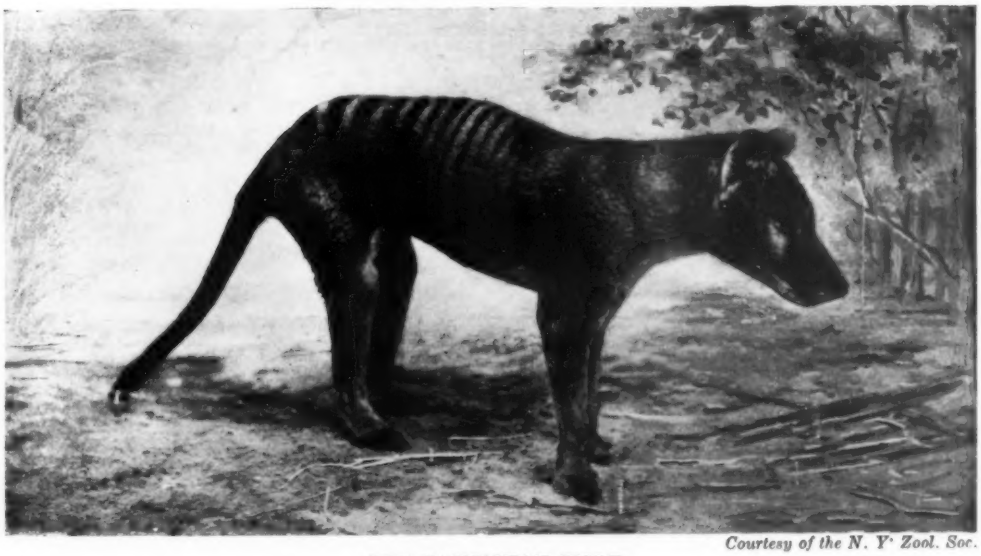
On another occasion one of them (during the night apparently) got into the kitchen at the lumber camp where I was staying, and proceeded to crawl into the oven of the stove, in which there was no fire. In the morning the cook closed the oven door, lit the fire, and was amazed, when the stove began to heat up, to hear a frightful rumpus proceeding from his normally well behaved stove. Investigation showed him what caused the trouble, he promptly closed the stove again, and left it closed until the poor beast was dead. It was with great difficulty that I persuaded the men at camp that the animals could be carried safely by the tail.

Another pouched animal of Australia and Tasmania is the wombat (*Phascolomys*), a good-sized specimen of which will weigh more than a hundred pounds. Fossil wombats have been found of great size—some of them must have weighed as much as a grizzly bear—but nothing approaching that size is extant. They are vegetarians, living mostly on grass and leaves They dig deep burrows, and bring forth their young one at a time. Wombats are to be found in the southern half of Australia and in Tasmania, where they are hunted for their skins, which are sold widely in the fur market. The fur is somewhat grizzled, and their color is a grayish brown, but it must not be supposed that every skin one sees for sale as "wombat" is in reality wombat. Other skins often bear that name by the time they appear in the shops of furriers.

It cannot be said that wombats are dangerous, and yet one should use some care in reaching into their burrows after them. If the collector makes the mistake of putting his hand into a burrow and getting it between a wombat's powerfully muscled rump and the stones and gravel of the burrow wall, the animal is likely to push it very hard against the stones, and from such a predicament one can pull his hand only at the risk of leaving a certain portion of the skin behind. I have been told by experienced hunters, and I know personally, that the safest way to extricate one's self from such a painful position is to reach in with the other hand, and touch the wombat on the other side, whereupon he will immediately push toward the opposite wall, thereby releasing the imprisoned hand. The hunter must, of course, see that he withdraws both hands quickly else he will merely be out of the frying pan into the fire.

The largest of the marsupial carnivores to be found in Tasmania is the Tasmanian wolf (*Thylacynus cynocephalus*). Formerly it inhabited Australia as well, as numerous fossil remains in caves testify, but it is now restricted to Tasmania.

These animals are as long as a wolf, to which they bear certain superficial resemblances, but they are not so tall, nor are they so efficient. The dingo, which is a real dog, has probably been responsible for their extinction in Australia, but as this animal, which apparently came to Australia, probably from Asia, during the Pleistocene, has never penetrated to



Courtesy of the N. Y. Zool. Soc.

THE TASMANIAN WOLF
(*Thylacynus cynocephalus*)
The largest flesh-eating pouched animal known. It is at present very rare and inhabits only the dense forests and scrubs of western Tasmania

Tasmania, the Tasmanian wolf has been able to hold on there. These animals travel alone, while dingos, travel in packs, and with both man and dingos as enemies frequently the Tasmanian wolf was forced to give way. It seems possible, however, that his lease of life will still continue to hold in Tasmania.

Australia is still the home of many unique animals, but already many have been eliminated. The Australian native black, together with the dingos, some of which he has tamed, may possibly have been the cause of the extinction of the giant wombat as well as of *Diprotodon*, which was a huge, wombat-like animal as large as a rhinoceros. It seems possible, too, that *Palorchestes*, a kangaroo that stood, perhaps, fourteen or more feet in height, was eliminated by the same enemies; and the future of many of the present Australian and Tasmanian animals depends upon their protection from these same enemies. Some of them—such as certain of the arboreal, leaf-eating phalangers the food of which is not effected by rabbits—may survive, if their habits make it difficult for dogs, cats, and foxes to catch them. Platypus, too, if stringent laws protecting it from man are put into effect, will probably manage to survive, but other than these, it seems highly probable that every animal that I have mentioned is doomed to extinction within a tragically short period.

The modern world is not kind to animals. Man, and the animals that man has introduced, will most certainly eliminate the major portion of the strange and fascinating creatures that are typical of Australia and the adjacent islands. For millions of years these animals have been able to develop and thrive because the open seas protected them from more powerful and more efficient animals of other portions of the world, but now, with man's lust for killing, and with his introduction of foreign animals, the native species are bound to go. No longer do the seas protect them, and as yet man has not realized that it is to his interest to do so. The time has not yet come for their epitaph, but there can be little doubt that it will be in order before many more generations have passed.

A TRAIL THAT LED TO MONGOLIA

The Story of Roy Chapman Andrews, Whose Unquenchable Enthusiasm Has Carried Him to His Spectacular Achievements

By STEWART A. McWILLIAMS

TWENTY-THREE years ago a slim, light-haired young man, fresh from Beloit College, came into the office of Dr. Hermon Carey Bumpus, director of the American Museum of Natural History, and applied for a job—any kind of a job would do since there were no openings on the staff. He got the job—as a taxidermist, but for some time his main occupation was washing floors.

THE MEDAL OF THE GEOGRAPHICAL SOCIETY OF PHILADELPHIA RECENTLY PRESENTED TO DR. ANDREWS

That was the initiation of Dr. Roy Chapman Andrews into the realm of science.

"I didn't mind it, though," he says, "for I was working in a place where the men to me were as gods."

On January 21, this year, Henry G. Bryant, president of the Geographical Society of Philadelphia, conferred upon Doctor Andrews the highest honor in the gift of the Society—the Elisha Kent Kane Medal, emblem of distinguished work in the field of exploration, and hailed him as being not only a distinguished scientist but also a great leader and executive of the same type as Commander Byrd, the last man to receive the medal two years ago.

THE REVERSE OF THE ELISHA KENT KANE MEDAL

During the years since he began washing floors in the American Museum, Doctor Andrews' career has been one of varied and frequently spectacular achievement. His first field work—as a taxidermist—was carried out with James L. Clark, now assistant director of the Museum in charge of preparations, at Amagansett, Long Island, in 1907, where they skeletonized a whale.

This was only the start. The next year he traveled and explored in Alaska. He was recalled from a trip up the St. Lawrence River to be sent as special naturalist on the U.S.S. "Albatross" for a two years' voyage to the Dutch East Indies, Borneo, and the Celebes. He explored North Korea in 1911–12, and went with the Borden Expedition in 1913 to Alaska, where he made a series of studies of whales and other water mammals which gained him recognition as a leading authority on that subject.

In the performance of these tasks the qualities he constantly displayed of leadership, as well as his scientific ability, attracted attention. More than a decade previous, Prof. Henry Fairfield Osborn, president of the American Museum of Natural History and one of the world's foremost palæontologists, had prophesied that Central Asia would prove to be a great center of origin for much of the mammal life of Europe and North America. The time had now come when the American Museum was prepared to test out his theory, and Roy Chapman Andrews was made the leader of the now famous Central Asiatic Expeditions.

The progress of the four expeditions sent out under his leadership so far has been marked by a series of epochal discoveries. They have explored Thibet, Southwest China, Burma, North China, outer Mongolia, and are now delving into the great treasure house of pre-historic remains they have uncovered in the Gobi Desert. Their finds have ranged from fossil mosquitoes to dinosaur eggs. They have discovered the oldest known mammals, hundreds of new species of animal life, and remains of primitive human life and other evidences which have convinced Professor Osborn that in Central Asia lies the cradle of man.

They have used motor cars for the first time in their Gobi Desert explorations, opening this vast plateau to modern commercial methods of transportation. They have found many geological strata previously unknown, the skull and parts of the skeleton of the largest known mammal—*Baluchitherium*—and the bones of other creatures stranger than anything man had ever imagined.

It was "in recognition of the unusual executive ability shown" in organizing and completing these expeditions, his "high qualities of leadership" and "the remarkable results obtained in different branches of science" that the Kane Medal was awarded to Doctor Andrews, as Mr. Bryant declared, when presenting it to him. But in this tribute he failed to mention the outstanding and perhaps the greatest quality of the man.

Today, Roy Chapman Andrews is just as enthusiastic about his work as was the young hero-worshipper who came to the American Museum years ago. In a sense he is still a hero-worshipper. He is a firm believer in the qualities of scientists as men, and one suspects that he measures his own achievements not so much by their actual scientific value as by the magnitude of the difficulties overcome. It was this unquenchable spirit which gave him the courage last year to turn back with his expedition after months of dismal failure in the desert sands of southern Mongolia, and to strike into new territory to achieve a success even greater than he had hoped.

It is this attitude that enables him to keep his enthusiasm. One is inclined to feel that life is a succession of thrills to him—the thrills that come from overcoming great difficulties, from doing the things "which could not be done." When asked what has given him his biggest thrill, he confessed, "It is hard to tell," and after much hesitation he named the finding of the skeleton of *Baluchitherium* "because of the great size of the animal."

In his belief the personnel has been the biggest factor in the success of his expeditions. The scientific ability of his assistants is only a part of their qualifications. He declares that at least fifty per cent of their value is their ability to get on with other men.

Next to the human element he ranks a complete knowledge of the problems to be faced and careful preparation—down to the smallest detail, eliminating everything which may cause trouble by preparing for it in advance as much as is possible. Then, when the unexpected does occur, the emergency can be handled with the smallest amount of difficulty.

"But, no matter how carefully you prepare and study things out beforehand," he told a friend just before he started back to China, "something will always happen that you cannot possibly foresee. You never know what to expect. Still, that is one of the things which adds zest to the undertaking."

OGDEN MILLS
1856-1929

BY the death of Ogden Mills on January 29, 1929, the American Museum has lost a rare friend and a generous patron. He became a Trustee in 1910, when he succeeded his father, Darius Ogden Mills, whose many enterprises and interests he so faithfully carried on. During 1912 and 1913 he served as a member of the Auditing Committee and in 1914 became a member of the Executive Committee. The Museum has successively elected him a Patron, an Associate Benefactor, and an Associate Founder, in this way expressing esteem and gratitude to one who has been helpful in realizing the Museum ideal.

In building up an institution such as ours, with its wide scope and far-reaching influence, much depends upon the unseen forces which guide and shape its growth. Vision is needed, coupled with unerring judgment in choosing for development those phases of Museum activity which will prove of greatest benefit. Mr. Mills showed, through the many years of his useful life, just these needed qualities, and his fine discernment and square dealing in the field of capital and industry were carried over into the field of Museum administration. Known to his associates as a shy, kindly man, he had the underlying strength and wisdom characteristic of all great men.

Besides subscribing generously of his resources as need arose, he also chose to give of his interest and support to certain definite projects. Thus his name is closely associated with the construction of the fur seal group and with four of the Museum's expeditions, namely, the Crocker Land, the Fourth Akeley African, the Cañon del Muerto, and the Java expeditions. The scientific results obtained by each of these have amply proven their worth. Another of Mr. Mills's gifts is the series of Catlin paintings, which are now on exhibition in the Eastern Woodlands and Plains Indian Hall. When the opportunity arose to acquire these originals by the famous Indian painter, Mr. Mills, realizing their historic importance, at once made their purchase possible.

The Library, too, was favored by his interest. It had been his habit for some years to present, as they came into the market, rare volumes in Americana and in various branches of natural history, especially ornithology, including a number of first editions. Among them are:

GOULD, JOHN—27 volumes, including most of his famous monographs on the birds and mammals of Europe, Asia, and Oceania.

DE BRY, THEODORUS—Peregrinationes in Indiam Occidentalem. First Edition. 1590–1602.

DE BRY, THEODORUS—Peregrinationes in Indiam Orientalem. First Edition. 1598–1613

KINGSBOROUGH, LORD—Antiquities of Mexico. Colored Edition. 9 Folio Volumes. 1831–1848.

DE SPIX, J. B.—Avium species novæ, quas in itinere per Brasiliam annis MDCCCXVII–MDCCCXX . . . collegit et descripsit . . . J. B. de Spix.

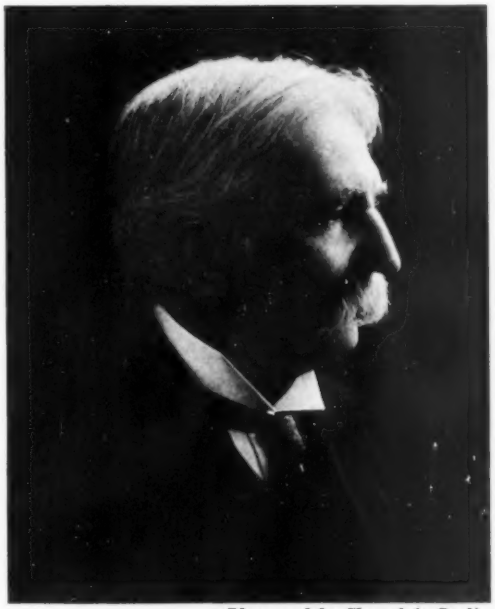
By these gifts and finally by the gift of the collection of some twenty thousand volumes belonging to the New York Academy of Sciences, Mr. Mills brought the Library of this Museum to its present high rank among scientific institutions of the world. Having learned of the desirability of a permanent amalgamation of the Academy Library with that of the Museum, he paid a personal visit of friendly inquiry and shortly thereafter offered to purchase and present to the Museum the Library in question. It is due to his foresight, therefore, that the Museum now owns not only many rare monographs but also those early volumes of scientific periodicals around which it had for years been building up its files.

On January 4, 1926, Mr. Mills was appointed chairman of the Trustees' Library Committee and he continued in this office until his death. Always a friend, he left as a final token of his high regard for the aims of the Museum a bequest which will greatly increase the present endowment fund.

FREDERIC AUGUSTUS LUCAS
1852-1929

By ROBERT CUSHMAN MURPHY
Curator of Oceanic Birds, American Museum

TO speak of Frederic A. Lucas as a many-sided personality would not do him justice. In reality he belonged to a disappearing generation of wise men, schooled during a period when minds were not so highly specialized as today, unafraid to contemplate the whole scope of natural science and capable of becoming familiar with a surprisingly large part of it. In him were traits reminiscent of Benjamin Franklin. Both men had enjoyed a minimum of formal education, but both shared the inquisitive intellect, the shrewd understanding, and the retentive memory that enabled them to store away, and yet have always at hand, a fund of information amazing in its quantity and variety. Doctor Lucas' brain was a loadstone; he was so likely to know the answer to things that he became the arbiter of all sorts of questions that can arise to interest or perplex museum men.



Photograph by Champlain Studio

FREDERIC A. LUCAS, SC. D.
Director of the American Museum of Natural History 1911-1923, and honorary director 1923-1929

To appraise our late honorary director at the height of his career, we must look back eighteen years, to the beginning of his term at the American Museum of Natural History. He was then fifty-nine years old, a slight man physically but springy and vigorous. In appearance and bearing he had changed very little for ten years. Neither did the succeeding decade bring perceptible alteration, for it was not until he had passed three score and ten that he can be said to have felt the weight of age. As the newly chosen director of the Museum he was entering upon the last stage of his career. What a foundation his extraordinary life had given him for this post!

From early childhood in Plymouth, Massachusetts, where, according to his own memory, his thoughts centered on animals, fishing, and other aspects of the out-of-doors, Lucas was taken by his father, a clipper ship captain, to the ends of the earth. Several times he crossed the Atlantic under sail. Twice he encircled the globe, spending months at sea. He strolled through the streets of Yedo (Tokyo), when the mere presence of a white boy, especially one with red hair, caused the Japanese to flock curiously in his footsteps. He witnessed stirring and bloody events at Shanghai, when the Chinese

showed early resentment against foreign penetration. He knew Peru in the terrible heyday of the guano traffic. Square-riggers in which he sailed dodged Confederate privateers through three oceans. And during all these wanderings his interest in natural history waxed continually; his notes and tabulations grew; his clever and faithful sketches, which are somewhat akin to the marginal drawings of a whaleman's logbook, multiplied. Seven pencil studies of totally unfamiliar fishes, made at the Chincha Islands in 1869, are today positively identifiable as to species. His notes on birds from the same region and period are just as usable as though made yesterday by an ornithologist experienced in that fascinating field.

Following his youthful voyages, Doctor Lucas began his labors at Ward's Natural Science Establishment in Rochester, an institution regarded as the great training school of natural history museums in America. The hours of work were from seven to six, and vacations were unknown, yet one gathers from Doctor Lucas' autobiographical notes that the leisure time of the Ward force was generally devoted to occupations related to the tasks of official hours. Among his associates of that period were Akeley, Townsend, and Hornaday, and the whole crew seems to have been filled with divine afflatus. Aside from the training in taxidermy and other museum methods, Doctor Lucas acquired at Ward's that extreme familiarity with the plan and variations of vertebrate skeletons which was to serve him so well in subsequent years. As he has remarked, one simply had to know bones before one could assemble perfect skeletons of a heron, an iguana, and a spider monkey, from a common disarticulated mess at the bottom of a maceration tub.

In 1882 Doctor Lucas went to the National Museum at Washington, filling various posts connected with administration and with the sciences of anatomy and palæontology until he was called to be curator-in-chief of the Brooklyn Museum in 1904. During his career at Washington, however, he had been able to vary his routine by expeditions to the Gulf of St. Lawrence, to Funk Island, where he excavated the bones of the great auk, to Bering Sea for a fur seal investigation of far-reaching importance, and to the modern whaling stations of Newfoundland, where he laid the basis of his wide knowledge of the larger cetaceans.

When he entered upon his work in Brooklyn, Doctor Lucas fully believed that he had taken up his final task, and he put his whole heart into a matured scheme to express a new idea. Although hampered to some extent by local traditions, he succeeded in developing a hall of vertebrates which in clarity of plan, beauty of material, and enrichment by exhibits of biological significance, has perhaps not yet been surpassed. Corresponding exhibits of invertebrates were also partly installed under his direction, and an equally comprehensive botanical hall would have followed if the course of his life had not again been turned by the totally unexpected, and half-regretted, call to the American Museum.

Of Doctor Lucas' eighteen years of service to our institution others are more competent to speak. It may be profitable, however, to consider a little further the peculiarities of temperament and education that fitted him for such eminent success. When and how had he acquired his multifold abilities? He was accustomed to refer to himself as a man of scant schooling, and yet, in addition to his understandable knowledge of natural history, he wrote peculiarly lucid and expressive English; he could quote Virgil, his favorite Latin author, apropos of almost any occasion; he could speak very fair French. He knew the history of

biological science almost as well as the evolution of the museum idea, and he was never at a loss for an apt citation of Herodotus, Olaus Magnus, or Scripture, as those of us know who are familiar with some of the thousands of museum labels that have come from his pen. He could navigate a ship or build a boat. He could prepare exquisitely the skeleton of a tiny and delicate creature, such as a nestling humming bird. He was a good judge of taxidermy because he was also master of it. Dexterity in manual work, in fact, he always held in high regard; tools and a carpenter's bench were not considered beneath the dignity of office equipment. His penmanship was bold, clear, and attractive, and he was a skilful draftsman. Many of his line drawings have been published, not only in his own scientific papers but also in encyclopædic works of a generation ago.

Although Doctor Lucas' fame will doubtless rest chiefly upon his accomplishments as a builder of museums, let it not be forgotten that the insight of a genuinely scientific mind lay behind all this wider expression. As a matter of fact, he was a gifted research worker, and some of his friends among distinguished naturalists, including Dr. William D. Matthew, deeply regretted that force of circumstance had torn him away from the keenly analytical studies in comparative anatomy which he had carried through earlier in life. These related to all the classes of vertebrates. In ornithology, for example, he was among the first in this country to turn from the inspection and comparison of skins to more fundamental parts of a bird's structure, and a long series of papers on the skeletons and soft parts of swifts, humming birds, woodpeckers, honey-creepers, titmice, gallinaceous birds, *Hesperornis*, and others appeared chiefly between the years 1889 and 1900, throwing much new light on the relationships of the families and higher groups of birds.

An outstanding example of the thoroughness and soundness of Doctor Lucas' anatomical investigations is that concerned with his views on the affinities of the penguins. When Stejneger, a master zoölogist, prepared the text on birds for the *Riverside Natural History* (1895), he grouped the penguins as a distinct super-order, equivalent in rank with the ostrich-like birds on the one hand, and with the Euornithes, or carinate birds, on the other. Lucas held strongly against this view, presenting excellent morphological reasons for his conclusion that the flightless, marine penguins are merely highly specialized members of the carinate sub-class, deserving of no very distinct rank in classification. Only in later years was this problem finally settled by further illumination of the embryology of penguins and by Wiman's researches on fossil penguins obtained during the Swedish Antarctic Expedition. The results entirely confirm Lucas' opinion.

Another triumph of his observations and their interpretation relates to his report on the Alaskan fur seal, after his residence at the Pribilofs during 1896 and 1897. The recommendations of the commission of which Lucas was a member were not only combated but were made to bear the brunt of violent calumny. We know, nevertheless, that the present flourishing state of the fur seal herds is due to action which he sponsored.

Doctor Lucas was a genial, deferential, always obliging, and sometimes almost shrinking, man, but anyone who mistook his self-effacement for moral timidity, or compromise with principle, was likely to be speedily enlightened. In addition to my association with him in museum work, we sat together for a number of years on the boards of directors of the National Association of Audubon Societies and the Explorers Club, and I have had occasion

to see how positive and unyielding he could be when the cause justified his position. His philosophy enabled him to take disappointment cheerfully, and he rarely expected to see even cherished plans carried out in their entirety. He often used an expression attributed to President Roosevelt, "Do what you can, now, with what you have."

The finest side of Doctor Lucas' character was always apparent in his courtesy, kindliness, and perennial humor. These traits never lapsed, even during times of trouble. He never wore his heart on his sleeve. During long weeks when he was worried to distraction by the last illness of Mrs. Lucas, he kept to his accustomed Museum tasks as much as possible and preserved his usual demeanor toward friend and stranger. He was full of whimsical stories, and his humor sometimes took a highly sardonic form, as in his famous regulations for the conduct of modern museums and the duties of the staff, beginning:

"A Museum is an institution for the preservation and display of objects that are of interest only to their owners.

"It is also a place where paintings, bric-a-brac, trophies of the chase, etc., may be deposited whenever their owner wishes to have them stored temporarily without expense to himself."

Doctor Lucas lived a long and rich life, and died practically in harness. We shall miss his comradeship and his inexhaustible funds of information, but the mellowness of his spirit will remain. If he had foreseen his end, I believe that he would have been content, and that he might have thought of the couplet inscribed on the title page of his unpublished bibliography:

"God be thanked, whate'er comes after,
I have lived and toiled with men."

"THE BRAIN FROM APE TO MAN"

A Review of the New Book by Prof. Frederick Tilney

By WILLIAM K. GREGORY
Curator, Comparative and Human Anatomy, American Museum

THE human brain with its twelve thousand million odd nerve cells[1] is an affair of such staggering complexity that there is some excuse for those who, like the present writer, too easily get lost in its super-labyrinths. Fortunately, the brain of the humble shark affords a key to the ground-plan of the human brain. Broadly speaking, the shark brain[2] as seen from above consists of a "nose-brain," an "eye-brain," an "ear-brain," a "skin-brain," and a "taste-brain," the latter grading into the spinal cord, while the "little brain," or cerebellum, rides on top of the eye-brain and the ear-brain. All these primary sensory centers are connected fore-and-aft in very intricate patterns by nerve fiber tracts.[3]

It has taken several generations of scientists to find out even in the most general way how this simple brain works. Suppose the shark's microscopic smelling organs, that are packed up in his rosette-like nostrils, get the scent of a piece of flesh floating on the water. The smelling organs thus stimulated send back their messages along the thick cable-like bundles of fibres of the olfactory bulbs to the forepart of the primitive end-brain or cerebrum. Here the discharge of these incoming currents sets off a new series of impulses that pass backward to various parts of the brain. Meanwhile perhaps the eyes have caught sight of the source of the odor and taste; messages from the eye-brain are flashed forward to the nose-brain and backward to the taste-brain. In general, the incoming messages or stimuli either reinforce each other or are balanced and played off against each other, so that after a very brief interval a definite "pattern," or make-up of messages is transmitted along the out-going motor nerves of the brain stem and spinal cord to the locomotor apparatus. The latter is set in motion, the shark turns and swims toward the desired object, and at the right moment the jaws open and snap, and the throat muscles pass the meat down to the eagerly waiting stomach. This, of course, represents the simplest form of reflex action, uncomplicated by inhibiting factors.

The shark's front and hind pairs of paddles are represented in man by great bony and muscular outgrowths, which are the human limbs, including the hands and feet. The backbone, no longer horizontal, has been turned in man into the vertical position, and the weight of the body is cleverly balanced on the hind limbs. Thus the simple locomotor apparatus of the shark has given place in man to one of great complexity.

The brain of man has likewise advanced beyond that of the shark in the elaboration of a vast system of new control centers, which have grown out of and around certain of the old ones and which have greatly increased the complexity of the reactions accompanying even the simplest acts. The first and most conspicuous of these newer outgrowths is the greatly furrowed surface of the "neopallium" or upper division of the forebrain. The "frontal lobes" of the human brain are believed on good evidence to be the supreme court where the often conflicting impulses from the lower centers are held in leash and directed toward the channels favored by habit or by reflection. The "parietal region" of the brain, as is well known, has much to do with the conscious control of the limbs; the "temporal lobes" and adjacent parts are concerned with the memory of sounds, with the associations of sounds with other sensory images, and with the correlated movements of the organs of speech. The "occipital lobe" is concerned especially with visualizing.

The second major part of the human brain, which reflects the greater complexity of the human organism, is the little brain, or "cerebellum," which now consists of three huge, greatly folded divisions, one in the middle, the others on either side.

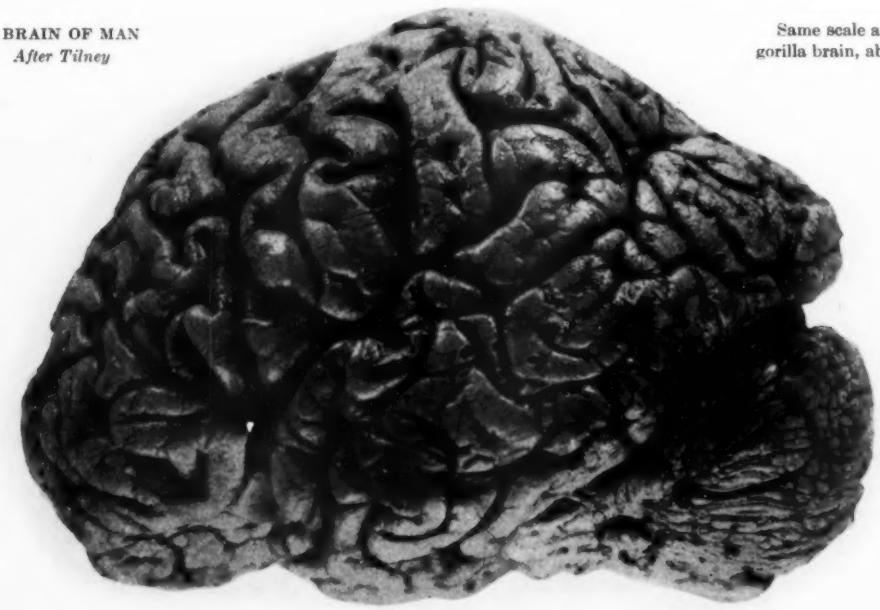
[1]Donaldson, quoted by C. Judson Herrick in "Brains of Rats and Men," p. 4. [2]*Ibid.* p. 71. [3]*Ibid.* p. 132.

BRAIN OF GORILLA
After Tilney

All this is preliminary to a brief notice of a recent work of the highest importance and interest entitled *The Brain from Ape to Man*, by Professor Frederick Tilney, the well known neurologist of Columbia University. The work also embodies chapters on the reconstruction of the brain stem of primates through the use of serial sections, by Dr. Henry Alsop Riley. The outer or surface areas of the brain having been treated by many other authors as well as in a previous work[1] by the same authors, the main theme of the present treatise is the comparative description and interpretation of the successive sections of the brain stem in a considerable series of primate mammals from lemur to man. The brain stem contains the great conduction cables that lead down from the higher surface centers to the spinal cord, and Doctor Tilney has been able to show that its complexity varies almost directly with that of the centers above it.

One of the main results of the laborious studies by Doctors Tilney and Riley is a fuller understanding of the evolution of *neokinesis*, by which is meant, in simplest terms, that in the mammals the new centers in the neopallium and other parts of the brain are tied in with, control, and partly take the place of the relatively simple reflex centers of the old shark brain. This "new movement" system becomes more and more complex as the capacity for skilled movements, as well as the general intelligence, steadily advances. There is good evidence for the inference that in the higher mammals, especially in man, the patterns of every posture, of every flowing stream of postural changes involved either in locomotion or in various special movements, as of the jaws and tongue, are predetermined by the neo-

[1] *The Form and Functions of the Central Nervous System.* New York, 1921.

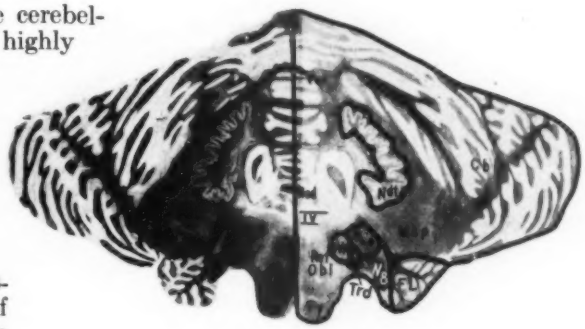


BRAIN OF MAN
After Tilney

Same scale as gorilla brain, above

pallium, made up chiefly by the cerebellum and transmitted through the highly complex brain stem to the executive organs of the body.

The mammalian order of Primates, to which man belongs, is remarkable for the fact that, as compared with many other existing orders, it contains an unusually large number of "living fossils," or missing links, which in various parts of the world have, as it were, fallen behind in the ascent and have been content to remain on lower levels of existence, while some of their more progressive relatives have toiled on toward the summit. Students of the evolution of the skull, jaws, and teeth, of the hands and feet, as well as of the brain as a whole, have long since recognized that while the existing lemurs, monkeys, and apes obviously do not lie in the direct path of man's ascent, yet when studied in comparison with the known fossil primates of past ages, they do preserve in varying degrees the successive stages of that advance. To this body of recorded facts concerning the structural gradations among the primates, Doctor Tilney has now brought an enormous accession of new material, which sets forth the indisputable general progression of the brain from the lowest primates to man.



CROSS-SECTION OF THE CEREBELLUM OF GORILLA

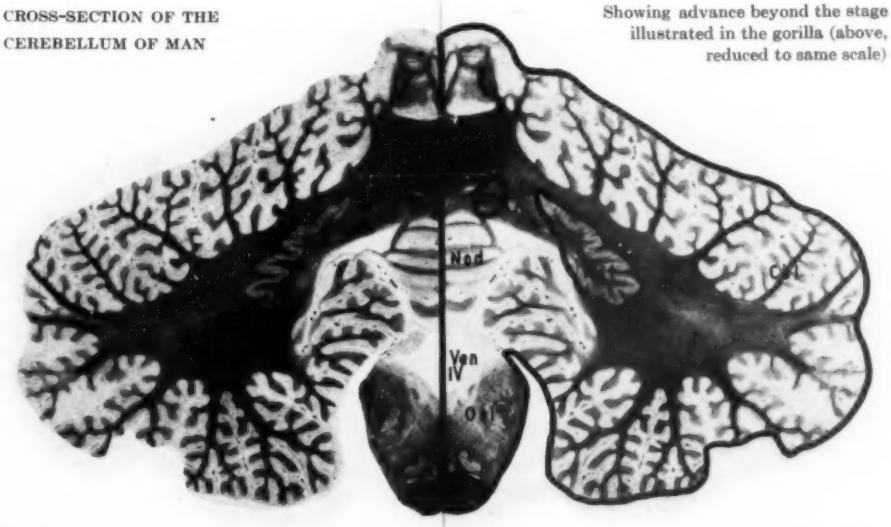
Showing the complex folding of the lateral lobes and the high development of the dentate nucleus. The complexity of these structures reflects the relatively high ability of the gorilla to perform skilled movements of the body and limbs

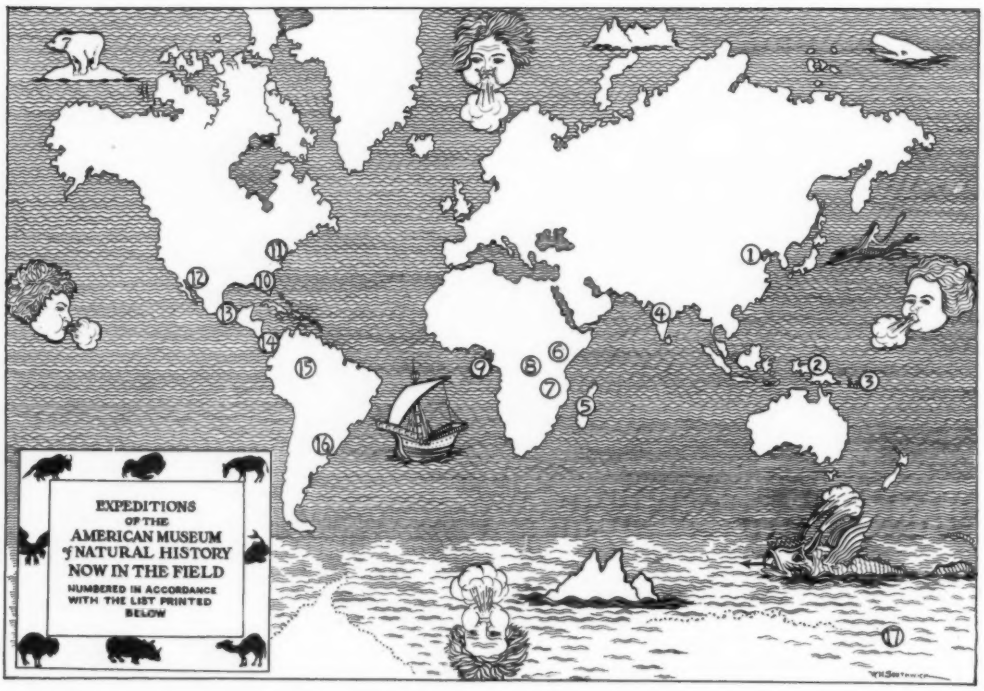
His studies also bring out more clearly than ever the fact that in respect to its brain structure, as in so many other ways, the gorilla is far nearer to man than he is to the lowest of the primates, so that from an evolutionary viewpoint there is now cumulative evidence for regarding the higher anthropoids as the backward and in certain respects specialized early branches from the primitive anthropoid base of the human family.

The publisher (Paul B. Hoeber) of this great work is to be commended for his courage and liberality in placing at the reader's disposal a store of costly, well executed plates in half-tone and colors.

CROSS-SECTION OF THE CEREBELLUM OF MAN

Showing advance beyond the stage illustrated in the gorilla (above, reduced to same scale)





1. Central Asiatic; 2. Beck, New Guinea, for birds: 3. Whitney South Sea, Solomon Islands for birds: 4. Vernay-Faunthorpe for Asiatic mammals; 5. Madagascar for birds, mammals, and fossils; 6. Sanford-Patterson-Legendre, Abyssinia for mammals; 7. Straus, to Nyasaland for birds; 8. Tanganyika for birds and mammals; 9. Sao Thomé for birds (Thorne-Correia); 10. Simpson, Florida for fossils; 11. Chester A. Reeds, Lake Passaic varves; 12. Sante Fé for fossils (Frick-Rak); 13. Vaillant, Mexico, for archæological finds; 14. Benson, East Panama for birds; Chapman, Barro Colorado for birds; Lutz, Panama, for insects; Blick, Honduras, for fossils; 15. Tyler Duida, Venezuela, for birds and mammals; 16. Southeastern Brazil (Naumburg-Kaempfer); 17. Byrd, Antarctic.

IN THE FIELD OF NATURAL HISTORY

Expeditions — Scientific Research — Conservation
Books — Meetings of Societies

EDITED BY A. KATHERINE BERGER

EXPEDITIONS

CENTRAL ASIATIC EXPEDITION.—Dr. Roy Chapman Andrews sailed from San Francisco on March 1 for Peking, where he will complete his plans for the next season's fossil collecting.

On February 4 President Henry Fairfield Osborn gave a farewell luncheon for Doctor Andrews at the American Museum at which he said:

> The last six years of Roy Chapman Andrews' work in Central Asia has probably made as large a contribution in the development of palæontology as have the preceding fifty years of exploration in the western part of the United States.

A distinguished gathering of explorers and scientists attended the luncheon.

INDIAN LIONS FOR THE AMERICAN MUSEUM.—The American Museum has received a cable from Arthur S. Vernay, in India, stating that he has procured fine specimens of a male and female lion for the Museum's Hall of Asiatic Mammals. This animal formerly ranged all the way from India through Asia Minor to Persia, but has become extinct over a large part of that territory. Today the Asiatic lion is found in only a small area in India, and is protected by the native princes. The Museum, therefore, feels that it is most fortunate in being able to obtain the specimens.

TYLER-DUIDA EXPEDITION.—Mr. Sidney Tyler Jr., who was taking an active part in this expedition, as well as generously financing the project, has been forced to return to New York because of a tropical infection which could not be properly treated in the field. The other members of the expedition have remained at Mt. Duida where they continue to collect the mam-

mals and birds of this little-known district of South America.

DR. FRANK E. LUTZ is now carrying on experimental work with tropical insects at the laboratories of Barro Colorado Island, Panama.

DR. GEORGE GAYLORD SIMPSON, associate curator of mammals, has been in Florida since February 1, and will continue during the month of March, making an extended trip over the entire state, collecting vertebrate fossils in collaboration with Mr. Walter W. Holmes of St. Petersburg, and the State Geological Survey of Tallahassee. In a letter dated February 13, Doctor Simpson reports finding a skeleton of a *Manatee* in a fuller's earth mine of Middle Miocene age—a rare fossil. Doctor Simpson's extended work will clear up many problems relating to the distribution of late Tertiary vertebrates in Florida.

ASTRONOMY

A MOST GRATIFYING EVIDENCE of the growing interest in the Amateur Astronomers Association was the attendance of 1426 persons at the recent lecture by Oliver P. Medsger, on Jupiter, accompanied by the motion picture of that planet made by Prof. William H. Wright of the Lick Observatory.

ON MARCH 6, Mr. Wallace J. Eckert, astronomer of Columbia College, gave an illustrated talk on "The Minor Planets: Asteroids."

MARCH 20, Dr. Henry Norris Russell, director of Princeton University spoke on "Analyzing the Sun."

APRIL 3, Garrett P. Service will tell of some "Experiences of an Amateur Astronomer."

APRIL 17, Mr. Worcester Reid Warner will describe a "Starry Night at the Lick Observatory."

STUDY GROUPS.—The Amateur Astronomers Association is now conducting the following study groups for the benefit of its members at the American Museum:

The regular meetings of the Amateur Astronomers Association are held every first and third Wednesday of the month at 8:15 P.M. For full information address Dr. Clyde Fisher, president, or Miss M. Louise Rieker, Secretary.

EDUCATION

A JUNIOR ASTRONOMY CLUB has been organized as one of the activities of the Museum's division of public education, in coöperation with the department of astronomy. Miss Elizabeth A. Eckels, staff assistant in education, will direct the members, who will be boys and girls from public and private schools that have attended the fall term of lectures and talks on astronomy given by Dr. Clyde Fisher and Miss Eckels. Children of members of the Museum will also be represented in the club membership.

It has been arranged that one half of the membership will meet from 8 to 9 P.M. on the fourth Friday of each month, and the remaining half at the same hour on the fourth Saturday, thereby making it possible to keep the attendance at each meeting sufficiently small to afford the children the best opportunity for star gazing through the telescopes used by the adults of the Amateur Astronomers Association.

The following program has been planned:

March 29 and 30—CLYDE FISHER, Jupiter and His Moons; Orion, the Mighty Hunter.
April 26 and 27—OLIVER P. MEDSGER, Venus and Mars; Canis Major, the Big Dog; Taurus, the Bull; Gemini, the Twins.
May 17 and 18—MISS JEAN CONKLIN, The Moon; the Great Bear; the Little Bear.
June 28 and 29—CHARLES LIEBMAN, JR., Sunspots (A Daylight Meeting).

THE NATURE TRAINING SCHOOL, under the general direction of the Coordinating Council, on Nature Activities, which was held last year at Camp Andree, Briarcliffe, New York, will be held at Gardner Lake, Connecticut (near New London) throughout the month of June, with three periods of two weeks each, June 1–15, June 8–22, June 15–29.

STUDY GROUPS OF THE AMERICAN ASTRONOMERS ASSOCIATION

LEADER	EVENING	TIME	SUBJECT	MEETING PLACE
Mr. C. A. Federer, Jr.	Every Tuesday	7:30 to 9:30 P.M.	Learning the Constellations	Astronomy Hall
Mr. S. L. Toplitz	Every Tuesday	8:00 to 9:30 P.M.	Location of Prominent Constellations	Room 201 School Service Bldg.
Miss Jean Conklin	Every Wednesday	7:15 to 8:15 P.M.	General Astronomy	Astronomy Hall
Mr. Frank Reh	First and Third Wednesdays	7:15 to 8:15 P.M.	The Stellar Universe, Nebulæ, etc.	Room 202 School Service Bldg.
Mr. Paul Shogren	Second and Fourth Wednesdays	8:00 P.M.	Elementary and General Astronomy	Academy Room
Mr. Cornelius Wolff	Every Thursday	8:15 P.M.	Light; and later, Elements of Physics as Applied to Astronomy	Room 202 School Service Bldg.

Telescopes, apparatus, steropticon, charts, blackboards, etc., are used.

Courses will be conducted in Forestry and Tree Study, Geology, Map Making and Surveying, Botany and Plant Ecology, Insect Life, Plant and Animal Life on Land and Water, Bird and Star Study, Outdoor Sketching, Photography, Indian Gardening and Lore, Music Interpretations with reference to Nature, Nature Education, Nature Excursions, Trails, and Games.

Following these June courses, and correlated with them, will be a trip of observation and study to the White Mountains in July, and in August a trip to Labrador especially for a study of the geology, botany, and ornithology of the Labrador coast area.

For full information concerning these courses write to Dr. Bertha Chapman Cady, Coordinating Council on Nature Activities, The American Museum of Natural History, 77th Street and Central Park West, New York City.

Oglebay Park School at Wheeling, Virginia, will also hold a training session from June 15 to 29, after which the students are invited to participate in the intensive field work program in the White Mountains and Labrador.

At the AVIATION SHOW held in New York City from February 6 to 13, the American Museum had a large booth devoted to a presentation of the important part astronomy has always taken in world exploration, and its close affiliation with present day exploration by air. The Museum's collections of meteorites, astronomical instruments, paintings, and books of travel attracted many visitors.

FISHES

A MEMORIAL TO DR. BASHFORD DEAN.—As a memorial to Dr. Bashford Dean, the present exhibit of fossil fishes in the southeast rotunda on the fourth floor of the American Museum is being enlarged and perfected, and will be known hereafter as the Bashford Dean Memorial Exhibit of Fossil Fishes. The work is in the hands of the Bashford Dean Memorial Committee, consisting of J. Leroy Conel, Hawthorne Daniel, Cleveland Earl Dodge, William King Gregory (chairman), Eugene Willis Gudger, Francesca La Monte (secretary-treasurer), John T. Nichols, Henry Fairfield Osborn, Mrs. George W. Perkins, George H. Sherwood, Bertram Smith, Alexander McMillan Welch. This committee is now engaged in having made a bronze bas-relief tablet bearing a portrait of Doctor Dean, that is to be placed at the entrance to the exhibit.

FOSSIL FISHES FROM MT. LEBANON.—Through the courtesy of Dr. Alfred Ely Day, the department of ichthyology is in receipt of a valuable exchange from the American University at Beirut, Syria, consisting of a collection of fossil fishes from the Mt. Lebanon district.

CONSERVATION

FORESTRY IN MOTION PICTURES.—To show fire-fighting, woods management, and other forestry principles and practices visually, the Office of Motion Pictures of the United States Department of Agriculture has prepared for the forest service of that department, thirty-five educational motion pictures on forestry subjects. Fire prevention, forest uses, reforestation, logging practices, recreation, and grazing are among the subjects covered. The films are loaned free for short bookings, or may be purchased at cost by outside agencies. Purchases are made through the Department of Agriculture.

HONORS

DR. ROY CHAPMAN ANDREWS was awarded the degree of Doctor of Sciences by Beloit College, Beloit, Wisconsin, on December 18.

DR. ROBERT BROOM, whose researches cover a period of thirty-three years in Australia and South Africa, was awarded the medal of the Royal Society at the anniversary meeting November 30, for his "valuable contributions to the determination of the relationships of the main groups of vertebrate animals, and to the definition and solution of the problems involved in the evolution of the higher groups."

THE MUSEUM LIBRARY has received as a gift the seven volumes of the Amiens Edition of *Sources Records of the Great War* which have been published by the National Headquarters of The American Legion. The volumes are registered in the name of The American Museum of Natural History and dedicated to the memory of CHARLES A. CONNOLLY of the American Museum staff, who gave his life while in the service of his country. Each volume has a distinct binding which in every case is a facsimile of the original art binding on the official copy of the Versailles Peace Treaty belonging to a stated country. The records are non-partisan, non-sectional, and non-sectarian, and will prove of increasing value as time goes on.

MINERALS

THE ADVANCE in the science of mineralogy that has marked the year 1928 may be said to express a tendency rather than a notable achievment. The science has largely outgrown the period of unrelated observation of facts, and has for more than a decade turned to the broad interpretation of existing data and those special investigations relating to the establishment of basic truths.

Much of this modernism in mineralogic research dates from the definite establishment of a knowledge of the atomic structure in crystals as revealed by the X-ray. Throughout the world more investigators are turning each year to this new and fruitful field of scientific endeavor, and the literature of 1928 has shown a high percentage of papers embodying new knowledge of the atomic structure and atomic groupings in crystals of minerals.

In the field of mathematical crystallography, a valuable compilation contributed to the literature of 1928 is the *Crystallographic Tables for the Determination of Minerals*, the work of Victor Goldschmidt and Samuel G. Gordon.

A number of new species have been discovered during the year, including two from the famous locality of Franklin, New Jersey.—H. P. W.

SCIENCE OF MAN

MONGOLIAN COLLECTIONS.—The latest collection of archæological material to arrive at the Museum is that obtained during the summer of 1928 by the Central Asiatic Expedition in south-central Mongolia. Mr. Alonzo W. Pond of Beloit, Wisconsin, who served as archæologist for the season, brought on the collection toward the end of January, having held it in Beloit since his return from the Orient last September in order to prepare his report on the same. Before this report can be published, however, it will be necessary to number and catalogue the specimens.

The new collection filled five moderate-size cases and comprises probably between 10,000 and 15,000 specimens. In quantity and general character this material corresponds pretty closely to that obtained by Curator N. C. Nelson in 1925 in west-central Mongolia. The 1925 collection is apparently stronger in culture levels; but the 1928 collection is somewhat richer in variety of artifact types, especially in objects made of bone. Both collections are however made up largely of flaked and chipped stone pieces; and of the 20,000 to 30,000 such objects now available, it must be emphasized that only a very small fraction are real implements, the vast majority being merely reject cores, flakes, and chips resulting from the production of implements. Nevertheless, our collections do furnish duplicates of a goodly series of typical stone tools and weapons, some of which, as has been repeatedly indicated, antedate the true Neolithic culture stage.

—N. C. N.

ENGLISH COUP-DE-POING.—An exceptionally large coup-de-poing, or hand-held implement of Chellean type, was recently brought for examination to the office of Honorary Director F. A. Lucas by the owner, Mr. P. L. Munford, of Decatur, Georgia. The tool, or weapon, in general outline and contour resembles a large spearpoint. It measures $2\frac{3}{4} \times 4\frac{1}{2} \times 11\frac{1}{2}$ inches and might have served a powerful man very well as a stabbing implement. According to the owner, this specimen, with eleven other flint artifacts, was found by his father, about the year 1865, at a depth of forty feet in the deposit composing an old bed of the river Oxe, near Leeds, Yorkshire, England. The rare piece is said to have been exhibited as a loan, in the British Museum for about thirty years.

Doctor Lucas very kindly brought the specimen to the attention of the department of anthropology and in response to our interest, and with the owner's consent, he superintended the making of four excellent casts, scarcely to be distinguished from the original. One of these casts has been placed on exhibit in the English Lower Palæolithic section in the archæological hall.

—N. C. N.

LAUSSEL SCULPTURES.—Through the continued interest and good offices of President Osborn, the department of anthropology recently received excellent casts of the two most important of five remarkable human rock-sculptures discovered about 1910 by Dr. Gaston Lalanne of Bordeaux at the great rockshelter of Laussel, near Les Eyzies, Dordogne Department, France. Doctor Lalanne having died recently, to the great loss of French prehistoric studies, the American Museum is deeply indebted to Madame Lalanne for permitting and superintending the castings.

Illustrations of both these bas-relief sculptures are given in Professor Osborn's *Men of the Old Stone Age*, pages 328–9. One represents a woman holding in her raised right hand a curved horn, and is executed in considerable detail, except that the lineaments of the face are not brought out. The other is the incomplete figure of a man, thought by some to be represented in the act of drawing a bow or throwing a spear. Both figures are done in about two-fifths natural size. The rockshelter yielded three additional female figures, the best one of which found its way to the Ethnographic Museum in Berlin, where it is to be hoped we may ultimately obtain a suitable cast. The two specimens available have been placed in one of the two Palæolithic Art cases in the archæological hall.

—N. C. N.

THE SHOEMAKER LOAN EXHIBIT.—Recently, Mr. Ernest Shoemaker of Brooklyn, a long-time friend of the Museum, placed in our archæological hall an interesting loan exhibit of 1000 selected specimens. This collection, which is to remain

on exhibit for a term of five years, is of interest for several reasons. It comes from the District of Columbia and can scarcely ever be duplicated. It comes from 22 definitely known sites, situated for the most part along the banks of the Potomac and Anacostia rivers. It is fairly complete and representative for the general region in question. Finally, it represents the avocational interest of Mr. Shoemaker—begun when he was eleven years of age—during his residence in Washington between the years 1877 and 1892. The collector modestly explains, however, that he received his inspiration, as well as some specimens, from his uncle, Dr. Wm. L Shoemaker, who began collecting in the locality before the Civil War, and that, moreover, his own brothers, Dr. F. Shoemaker, C. W. Shoemaker, and George Shoemaker, also made minor contributions to the final inventory, now totaling about 2500 pieces. In other words, the Shoemaker collection is, as it were, a family monument.—N. C. N.

PALESTINIAN FLINTS.—A collection of 265 chipped flint artifacts from surface sites in Palestine and from rockshelters in the vicinity of Beirut, Syria, was transmitted to the department of anthropology early in January. This shipment, together with a fossil collection, was sent to the American Museum last summer by Prof. Alfred Ely Day, of the American University of Beirut, and is important to us, being the first archæological material from southwestern Asia so far obtained by the Museum.—N. C. N.

THE AMERICAN MUSEUM'S small but growing collection from Lapland has been enriched by the gift of a Lapp woman's fur coat, presented by the noted author Hendrik Willem Van Loon.

A CACHE OF STONE DART POINTS has been forwarded to the American Museum by L. E. Bryant, Roberta, Tennessee. Forty-seven of these points, all of the same form, were found in a rockshelter, beneath a flat stone. From time to time such caches are found, indicating that even primitive man was thirfty in accumulating a store of weapons to be available in times of need. On exhibit in the Museum's archæological hall, on the second floor, is a large case filled with a cache of chipped blanks from which points could be made. This is one of the largest caches so far discovered in North America.

OBITUARIES

In the death of Mr. CYRIL GUY HARROLD the Museum has suffered the loss of a very able man. Mr. Harrold was born in England in 1895 and died in New York, February 4, 1929, of meningitis. For the past fifteen years he had been residing in Western Canada and making expeditions into parts of Labrador, the Canadian Northwest, Alaska and the Aleutian Islands. His interest lay principally in birds, and with them he was remarkably well acquainted.

A recent paper written jointly with B. W. Cartwright is entitled "An Outline of the Principles of the Natural Selective Absorption of Radiant Energy' and was published in *The Auk* during 1925. In it is developed the author's interpretation of the meaning of color in birds and of the nature of the chemical changes that have to do with the seasonal fading in the hues of feathers.

Mr. Harrold was on the eve of sailing as a member of the Madagascar Expedition which the American Museum is about to send in coöperation with the British Museum of Natural History and the Paris Museum of Natural History. To this undertaking he had devoted his heart and energies for several months. His passing is mourned by all of those who knew him.

As the magazine goes to press, word comes that DR. JONATHAN DWIGHT, research associate in North American birds, died at his home in New York City, February 22, 1929.

WILLIAM L. UNDERWOOD, widely known in the field of natural history, died on January 28 at Belmont, Massachusetts. Mr. Underwood studied and wrote on bacteriology as applied to the canning and preserving industries, and also devoted much time to the problems of the gypsy and the browntail moths, and to mosquito extermination.

NEW MEMBERS

Since the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total number 11,056.

Benefactor

Mr. GEO. F. BAKER, JR.

Associate Benefactor

Mesdames WILLIAM H. BLISS, G. LISTER CARLISLE, JR.

Messrs. JOHN F. ARCHBOLD, G. LISTER CARLISLE, JR., CLARENCE L. HAY, B. T. BABBITT HYDE, O. G. JENNINGS, J. S. MORGAN, JR.

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Mesdames A. Wentworth Erickson, George W. Perkins, Keith Spalding, Oscar S. Straus, Henry White.

Misses Gertrude Sanford, Ruth V. Twombly.

Messrs. Edward S. Clark, Glenn Ford McKinney, George N. Richard, John L. Severance, Keith Spalding, George F. Tyler, Sidney F. Tyler, Jr.

Fellows

Mrs. Katherine Pomeroy.

Messrs. F. Kingsbury Curtis, Van Campen Heilner, Henry Hornblower, W. H. Perkins, Ralph Pulitzer, F. W. Roebling, Jr.

Honorary Life Member

Mr. Herman Mueller.

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AUTHORS IN THIS ISSUE

Roy Chapman Andrews' brilliant leadership of the Central Asiatic Expeditions of the American Museum, and the world-wide interest in his publications, both scientific and popular, have won him a whole succession of honors and international distinction among explorers. His article in this issue "Further Adventures of the American Men of the Dragon Bones" brings the reader up to date on the experiences of the latest Asiatic expedition.

A trip around Cape Horn when he was a young lad, aroused in **John T. Nichols** so great an interest in the birds and fishes of the stormy Southern Ocean, that he later made a second trip, and though he has been curator of ichthyology at the American Museum for a number of years and has published much on fishes in general, his article in this issue entitled "At the Edge of the Antarctic Ice" proves to the reader how keen an interest Mr. Nichols still retains in those southern seas.

G. Lister Carlisle, Jr., the author of "Eleven Weeks in a Lion Pasture," was for eight years manager and part owner of a gold mine in Honduras where, in the intervals left to him by his work, he developed that intense interest in nature that ultimately caused him to organize the Carlisle-Clark Expedition to Africa. Mr. Carlisle's interest in animals is principally concerned with their conservation, and his own activities in the field are almost exclusively connected with the making of motion pictures of wild life. He has generously donated the lion group for the Akeley African Hall at the American Museum, his interest in which originated with his acquaintance with the late Carl Akeley. His article in this number of NATURAL HISTORY tells of the Carlisle-Clark Expedition, and especially reflects his interest in conservation.

When Rebecca Harding Davis, the authoress, visited Waynesville, N. C., some fifty years ago in search of local color, she bore a letter of introduction to the lawyer father of ten-year-old **Eugene Willis Gudger.** She took a liking to the boy, and when she returned home, sent him a copy of John Abbott's *Land and Water.* This book aroused in him a great interest in natural history, which subject he studied and afterward taught, becoming professor of biology at the State College for Women at Greensboro, N. C., in 1905. Here, in his leisure hours, he managed to turn out research work of such quality as to attract the attention of Bashford Dean. As a result, Doctor Gudger was invited to come to the American Museum in 1917 to work on the *Bibliography of Fishes,* and in 1919 Doctor Gudger became editor of Volume 3 of this great work. His article in this issue—"Wide-gab, the Angler Fish"—lies in the field in which he has specialized.

By an interesting coincidence, the publication date of this issue of NATURAL HISTORY is the twentieth anniversary of **Dr. Frank E. Lutz's** coming to the American Museum as assistant curator of invertebrate zoology. Later, when entomology was restored to the dignity of a separate department, he was made its curator. In addition to carrying on the more ordinary museum activities, the department has for the past four years maintained in the Harriman State Park a field laboratory where physiological work such as that described in Doctor Lutz's article, "Experiments with Wonder Creatures" has been done. However, this field station has not been devoted solely to research, for it was there that Doctor Lutz developed the "Nature Trail" method of outdoor education now being used in hundreds of places throughout this country and abroad.

Robert T. Hatt, assistant curator in the American Museum's department of mammals, who writes the "Odyssey of a Ground Squirrel," has devoted several years of study to the life histories of various North American rodents. Readers of NATURAL HISTORY will recall with pleasure Mr. Hatt's "Br'er Rabbit's Widespread Family" which appeared in the September–October number of last year.

Otis Barton especially interested in fossil primates of the Miocene and Pliocene. His article "Fossil Bones in a Persian Garden" describes his experiences in Persia last summer while searching for fossil remains.

Stewart A. MacWilliams, of the American Museum's department of printing and publishing, is a co-author of *China's Backgrounds,* a brief survey of China's art and culture. His interest in matters Chinese has fitted him especially to give to the readers of NATURAL HISTORY the personal glimpse of Roy Chapman Andrews that appears in this issue under the title "A Trail that Led to Mongolia."

"SUNSET IN THE GOBI"

In **A. A. Jansson's** painting that appears as the cover of this issue, the artist has caught, accurately, the color and the atmosphere of the Gobi Desert as the sun colors the western sky. When the painting was shown to Dr. Roy Chapman Andrews, whose long experience in the Gobi has made him the ideal critic of such a painting as this, and he was asked to make any suggestions for changes or corrections, he looked at the canvas for a moment and shook his head: "There is not a thing in it that I would have changed," he remarked. "The coloring is absolutely faithful to nature. The details are entirely correct. Even the man in the foreground bears a close resemblance to one I have long had on my expeditions. No, don't change it. That is the Gobi."